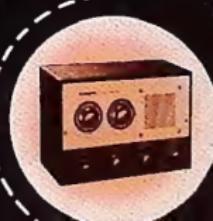
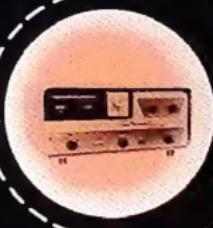


building up your ham shack

by HOWARD S. PYLE • W7OE

*formerly Assistant U. S. Radio Inspector
and License Examiner*

An up-to-date handbook for the novice
who has already received his ticket,
those aspiring to hamdom, and the
experienced ham.



A *Ham W. Sams* [®] PHOTOFACt PUBLICATION

July 12, 1961

\$2.50

Cat. No. NHP-1

building up your ham shack

by HOWARD S. PYLE • W7OE

*formerly Assistant U. S. Radio Inspector
and License Examiner*



HOWARD W. SAMS & CO., INC.
THE BOBBS-MERRILL COMPANY, INC.
Indianapolis • New York

FIRST EDITION

FIRST PRINTING — DECEMBER, 1960

BUILDING UP YOUR HAM SHACK

Copyright © 1960 by Howard W. Sams & Co., Inc., Indianapolis 6, Indiana. Printed in the United States of America.

Reproduction or use, without express permission, of editorial or pictorial content, in any manner, is prohibited. No patent liability is assumed with respect to the use of the information contained herein.

Library of Congress Catalog Card Number: 60-53510

PREFACE

This book is intended to supplement my previous volume, *ABC's of Ham Radio*, which is devoted to helping the prospective radio amateur pass the required Federal Communications Commission license examination. The information contained herein will be of value to both the advanced amateur who is anxious to update his station equipment, and the novice who needs help in choosing initial equipment which will be the most beneficial for immediate as well as future use.

In addition to discussions of the basic equipment needed to assemble and place on the air a simple, efficient, and effective amateur radio station, you'll be guided in the choice of advanced equipment so that you can gradually upgrade your station until it becomes the envy of the airways. Furthermore, suggestions on "trading-up" will help you attain this goal with a minimum of expense. Wide leeway is provided in the choice of equipment, including both factory-built and tested instruments, as well as popular "do-it-yourself" kits. No attempt has been made to teach you how to construct equipment "from scratch" because this information is amply covered in numerous periodicals and handbooks.

It is my sincere belief that the suggestions and instructions contained in the following pages will be invaluable in helping you achieve maximum pleasure and satisfaction from assembling, updating, and operating your amateur station. "73 and clear."

HOWARD S. PYLE

Mercer Island, Wash.
November, 1960



TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION	7
--------------------	---

CHAPTER 2

CHOOSING A RECEIVER	13
---------------------------	----

Factory-Built Types—Used Receivers—Receiver Kits—Military Surplus Receivers—Homemade Receivers

CHAPTER 3

CHOOSING A TRANSMITTER	29
------------------------------	----

Factory-Built Transmitters—Transmitter Kits—Used Transmitters—Building Your Own Transmitter—Surplus Military Transmitters

CHAPTER 4

THE RADIATING SYSTEM	47
----------------------------	----

The Random-Length Wire — The Center-Fed Dipole — The "Folded" Dipole—The Windom "All-Band" Antenna—"Restricted-Space" Antennas — Miscellaneous Antennas — Antenna Support Structures

CHAPTER 5

MISCELLANEOUS EQUIPMENT	63
-------------------------------	----

Speaker—Headphones—Hand Telegraph Key—Crystals—Clock—Antenna Switch—Microphone—CONELRAD

CHAPTER 6

ARRANGING THE STATION	77
-----------------------------	----

Light and Power—The Operation Position—Equipment Placement

CHAPTER 7

TESTING AND MEASURING EQUIPMENT	91
Simple Buzzer Tester—Volt-Ohm-Milliammeter—Additional Test Equipment	

CHAPTER 8

THE NOVICE HAM WORKSHOP	97
-------------------------------	----

CHAPTER 9

STATION SUPPLIES, CLUBS, AND OTHER ORGANIZATIONS	105
Station Logs—Message Blanks—QSL Cards—Radio Call Book—Miscellaneous Station Supplies—Clubs and Other Organizations	

CHAPTER 10

PREPARING FOR ADVANCEMENT	115
Technician Class—General Class—Conditional Class—FCC Formal Examinations	

APPENDIX A

AMATEUR RADIO BANDS	123
---------------------------	-----

APPENDIX B

THE AMATEUR'S CODE	124
--------------------------	-----

APPENDIX C

CONELRAD RADIO ALERT INFORMATION	125
--	-----

APPENDIX D

THE "C" AND "E" FREQUENCIES	127
-----------------------------------	-----

CHAPTER 1

INTRODUCTION

Be you boy or girl, man or woman, if you've decided to read this book, we assume you are or have decided to become an amateur-radio operator. This is made possible through the novice-class license issued by the United States Federal Communications Commission. Only a most elementary written examination, plus familiarity with the International or Continental Morse radio-telegraph code at a very slow speed, are required. As a novice, you will find an exciting new world unfolding before you. Communication through space, with no visible connecting medium, provides a thrill no other hobby affords. And you are not limited to your *local* area! Think of the exciting pleasure when you talk to another novice hundreds, even thousands, of miles distant! Such a feat is possible with even the most rudimentary equipment.

As a novice, you are of course limited in the amount of power you can use, as well as in the bands you can operate on. You learn this as you study the requirements for your novice license examination; you also learn that your equipment must be crystal controlled, and why. After you pass the general-class examination, these restrictions are lifted and the entire world of ham radio then becomes your playground.

Even as an apprentice, however, you have broad horizons in which to cavort, through the medium of the mysterious waves you generate in the ether. Whether your equipment is "built from scratch," from factory-built kits you assemble and wire yourself, or consists of completely assembled, wired, and tested factory instruments, is of little consequence. It is *you* who have assembled the station and acquired the skill to communicate with other hams all over the world; *yours* is the thrill of world-wide communications.

To enjoy these breath-taking experiences, it is of course essential that you have the proper equipment, and that you learn how to adjust, tune, and operate it. You must also acquire some proficiency in the radiotelegraph code and in the various operating procedures. The code is part of your training to qualify for your license; operating procedures should also be included, although you will not be examined too thoroughly on this subject. The more knowledge you *do* acquire on conveying intelligence by radio code as well as by the phonetics of speech, the more confidence you will have in establishing communication with some other novice station on your first on-the-air tryout.

You probably found that learning the code at five words per minute was somewhat difficult. It is encouraging to know that the code characters will become easier to interpret as your speed increases. Naturally, your speed will depend on the amount of time you can devote to listening to actual transmissions. This may be either through listening to other stations via a communications receiver, from an automatic tape device such as a paper-tape transmitting machine, magnetic tape recordings, phonograph records, or hand sending on a code-practice set with the aid of some friendly, experienced amateur.

As you acquire proficiency in the code, the urge to converse with the stations you hear will grow. You *cannot* do so, however, until an FCC novice radio amateur license—including (on the same form) a *separate* license for your *equipment*—is actually in your possession. The station portion of such a license will include the official call letters assigned by the FCC to your equipment. Once this license form is actually in your possession, including the official call letters appearing thereon, nothing in the world (other than lack of equipment) can prevent you from going on the air. If you do not yet have your equipment, you will be impatient and will regret the time involved in shopping for equipment, assembling and wiring it if in kit form, or perhaps building it yourself. You will want to get in there and pitch, the day the mailman leaves the coveted “ticket” in your mail box!

Why not get the jump on your license? There is nothing to prevent you from acquiring your station equipment while you study for the license examination—or even before. You’ll be faced with certain restrictions on its *use* until you actually receive your license, but at least you can be ready when it comes. Your communications receiver is your first consideration. It requires *no* license to operate, and you are free to use it the minute it is unpacked. This will provide you with many hours of practice in listening to other stations, and will be of enormous assistance in familiarizing you

not only with the code itself, but with much of the amateur operating procedure as well. Choice of such a receiver is discussed in detail in Chapter 2.

Your transmitter is another story. Whereas you can use your receiver the minute you get it, use of your transmitter is *absolutely forbidden* by law until your license arrives. Your study for the examination will reveal that to use your transmitter without a license can result in a heavy penalty which can flatten your wallet fast. Without a license, you would have to use fictitious call letters to identify yourself. This is known as "bootlegging," and it is a serious offense. Not only can heavy fines be assessed for such illegal operation, but you may also hear the disturbing clang of a jail door, should the offense be serious enough.

Just like your receiver, however, there is no law against procuring your transmitter at any time prior to receiving your license, or even before starting to study for the examination. In fact, if you can afford a transmitter after purchasing your receiver, by all means get one. (Chapter 3 will be of value to you in this matter.) Should you select a kit to assemble and wire yourself, you may do so with no restriction *except* one: you may not test it in any way which will cause radio-frequency energy to be radiated into free space, even though it may be received no farther than your next-door neighbor! The same restriction naturally applies to home-built gear or a completely factory-assembled, wired, and tested transmitter.

The transmitter *can* be tested with a dummy antenna, or by actually being put on the air at the station of some licensed ham friend. He can use your transmitter at his station. But he *cannot* operate it at your location, even using his own call with the portable designation.

Use of a dummy antenna can be a legal test, even by an unlicensed person, provided the radiation is confined strictly to the device being used. Commonly, an ordinary incandescent light bulb is used for this purpose. Although a rather ineffective antenna, it is possible to radiate signals generated into a dummy load for several hundred feet—and frequently, several miles! Such radiation is, of course, completely illegal unless instituted by a person holding a valid amateur-radio operator license. Our advice to prospective novices, not yet licensed, is an emphatic DON'T. Even though notified that you have passed your novice examination, you *still* cannot radiate a single dot until the actual license form is in your hands! Furthermore, you have not yet acquired sufficient experience to accurately determine whether your dummy antenna is radiating beyond the confines of your property or not. It is not our intent to alarm you with talk of possible penalties, but to impress you

with the fact that you are dealing with one of the few hobbies under Federal control; and even though the FCC is understanding, it is still legally bound to enforce the law. The momentary thrill you may get from a few illegal dots on the air is hardly worth the possible repercussions it could cause.

Once your transmitter is completed, checked over by one of the "ol' timers," and pronounced ready to go, put it away on a shelf in a dark closet. Hide it under a paper or cloth dust cover, if necessary, until you get your license. Don't go in the closet every few days to drool over it. Such procedure has often resulted in temptation becoming overpowering to the point where "just putting it on the air for a minute or so can't do any harm" In a number of instances, such "innocent" tests have had dire results! Remember that the FCC maintains many very efficient monitor stations manned by skilled engineers—equipped with all sorts of radio-signal tracking devices—who don't miss much in their round-the-clock listening and tuning. Likewise, volunteer observers of the American Radio Relay League, the international organization of radio hams throughout the world, are constantly on the alert for such violations, in the interest of maintaining the high standards amateur radio enjoys. You may also hear from them if you are a cheater. Sportsmanship is just as vital in ham radio as in athletics or any other hobby or sport. You're going to make a lot of friends on the airlines if you play the game. But if you incur the wrath of other, ethical hams by "jumping the gun" and operating illegally before you have your license, not only will you be subject to Federal penalty, but your fellow hams may shun you if and when you get back into the FCC's good graces and on the air legally.

So, provided you are willing to abide by the rules, it is actually to your advantage to procure your transmitter while you are pursuing your study for the examination, or even before you begin. This is particularly true of kit-type equipment, for as you unpack it and check the various components against the packing slips, you will begin to familiarize yourself with capacitors, resistors, inductors, transformers, chokes, etc.—all vital elements in any radio transmitter. As you follow the instructions for assembly and wiring, the familiarization process continues; and by the time you have completed the kit, you will have a fairly comprehensive idea of what a radio transmitter consists of. To a lesser extent—but still valuable in acquiring knowledge of parts, placement, and wiring—is a completely assembled, wired, and tested factory-built transmitter. Take it out of its cabinet when you receive it; study the accompanying instruction book and identify the various parts as best you can. In this way you will have a much better conception of radio transmitter design

and construction. Valuable information of this type will rub off even more if you have chosen a circuit design and constructional data from a publication that details the procedure for building a transmitter "from scratch." Regardless of how it is accomplished, contact with the various radio components can only be educational in this fascinating field—to what extent depends almost entirely on the degree of interest you develop.

In the following pages, you will find photographs of various items of equipment. These by no means represent the *only* apparatus available. There are *hundreds* of reliable manufacturers producing equipment for amateur communication use. Obviously it is impossible to show the offerings of all manufacturers in a book of this kind. Those illustrated here are therefore only a few examples of the equipment available from many sources, but they are representative of the type of amateur apparatus you have to choose from. We strongly recommend that you study the advertising in the top-quality ham periodicals, and send for the catalogs and literature offered. No reputable magazine will knowingly accept advertising from questionable firms. You can buy with confidence from the advertising pages of these periodicals, as well as from the catalogs of their advertisers.

The foregoing paragraphs constitute a preliminary run-down of the highlights entering into the *equipment* side of the novice ham station. Although we mentioned transmitter construction and wiring, little was said in the same vein about receivers. This was purposely done, and in Chapter 2 you will learn why. In addition, the minor items of station equipment (from the cost standpoint, at least) such as antennas, CONELRAD monitors, key, and similar accessories will be discussed in the appropriate chapters. You will gain more detailed knowledge of what ham radio is all about, and this will lead you to the eventual establishment of an efficient novice amateur radio station. It will prove to be a constant source of pleasure and pride—one you can proudly display to your friends, be they other hams or merely interested visitors.



CHAPTER 2

CHOOSING A RECEIVER

FACTORY-BUILT TYPES

Your first piece of equipment should be a suitable receiver, and it should be procured as early as possible. If you can also obtain your transmitter at the same time, it will enhance your knowledge of amateur radio as a whole. We will be concerned in this chapter with only the receiver; the transmitter we will leave until a later chapter. You'll probably buy a receiver first, anyway.

Note that we said a "suitable" receiver. That immediately raises the question, "What is concerned suitable?" Just as automotive and small-boat manufacturers offer many choices of body and hull styles, so do manufacturers of radio receivers. We have broadcast receivers, which are further broken down into AM and FM types; television receivers, which combine audible voice reception with the visual portion, etc. We also find receivers for many other purposes. There are those designed purely for the Citizens Band, for use in taxicabs, utility cars and trucks, and police, ambulance, and other emergency vehicles. Mobile receivers exclusively for amateur use are also available, as are special types for marine services and many other applications.

In addition to the mobile types, amateur-radio receivers are also available in many other classifications. Nevertheless, they all have one thing in common—they must be *communications* receivers first. In other words, amateur radio is primarily a *communications* service. Communication in this sense is the exchange of intelligence by means of the spoken word or its equivalent in the characters of the radiotelegraph code. This is accomplished by propagation of Hertzian waves (named for Professor Heinrich Hertz, an early scientist and experimenter) through free space. By modulating these waves with voice frequencies, we can achieve radiotelephony. Breaking the radiated wave into dots and dashes, to replace the modulation of the human voice, constitutes radiotelegraphy. The radiated wave



National's NC-109, at \$169.95, is a receiver which both the novice- and general-class ham can be proud of.

in both cases is referred to as the *carrier*. In radiotelephone operation the carrier wave serves to transport the modulated sounds of the voice or equivalent (tone or music, for example) superimposed thereon. This carrier remains on the air continuously during periods of transmission. (We are speaking, of course, only about systems used in equipment applicable to the radio amateur novice.) In amateur radiotelegraph work, *nothing* is superimposed on the carrier wave (although in the novice 145-147 megacycle band it may be modulated with an audible tone). Because the latter is seldom used, we will consider only the pure radio-frequency carrier without modulation of any kind. For the CW (continuous-wave) telegraphy used by the majority of novice amateurs, the carrier wave is merely started and stopped by operation of a telegraph key, like your code-practice set. Manipulated by an operator skilled in the radio code, the key acts as a switch to rapidly turn the carrier on and off in order to form the dots, dashes, and spaces of the code. The code characters, properly made, then convey intelligent symbols representing words, figures, punctuations, and phrases to the receiving operator.

Many receivers are incapable of receiving an unmodulated carrier, and therefore cannot ordinarily receive signals in the radiotelegraph code. Standard broadcast receivers are in this category. In fact, were they capable of such reception, it would probably prove detrimental to those interested only in the reception of voice and music. Neither can such a broadcast receiver, unless it is an all-band receiver, ordinarily receive *amateur* radiotelephone transmissions. To put it another way, all standard broadcast stations

in the U.S. operate between the frequencies of 540 and 1600 kilocycles. Amateur stations occupy from 1800 kilocycles to 30,000 megacycles and above, although they are divided into several narrow bands, each representing a small portion of the frequency spread (See Appendix A for a chart of the amateur frequency bands.) Sandwiched between these amateur bands are thousands of frequencies allotted to commercial interests, government and military communications channels, and to short-wave stations of broadcast and other categories throughout the world. Such frequency allocations, because radio waves are capable of penetrating every point in the world, are determined by international agreement arrived at through the co-operative efforts of practically all civilized nations.

On the other hand, most all-band broadcast receivers can receive *modulated* radio signals (usually the human voice, music, and other forms of entertainment), including domestic and foreign short-wave broadcasting stations, *amateur* radiotelephone, and similar modulated signals from many sources. They *cannot*, however, effectively receive radiotelegraph signals of the continuous wave (CW) like the novice amateur must use. How then does the novice communicate with other stations? He must have a receiver which includes a *beat-frequency oscillator* (BFO for short). This produces a heterodyne, or "beat," note and is in effect a miniature transmitter whose radiation does not extend outside the cabinet. By proper adjustment of components, a CW signal is created right in the receiver itself. Its frequency varies slightly from that of the transmitting station, dependent on adjustment of the controls by the receiving operator. Such a locally-generated signal, of infinitesimal power, beats against the incoming signal from the distant station. This produces a beat note representing the difference in frequency between the incoming signal and the minute energy generated by the BFO in the receiver. Its audible frequency is under the control of the receiving operator, who may produce whatever audio tone he deems most pleasant and desirable to copy. The tones most frequently selected for comfortable reception lie between 500 and 1500 cycles.

A receiver equipped with a BFO is known as a communications receiver; it is the type an amateur must possess in order to communicate with other ham stations. In addition to the BFO, most such receivers have several features not ordinarily found in broadcast receivers, even of the all-band type. The bandspread of a communications receiver is generally much greater; how much usually depends on how elaborate (and costly) the communications receiver is. Bandspread merely means the width of the channel on the dial has been extended considerably over that of noncommuni-

cations receivers. This permits much easier tuning and separation of the signals from various stations. Even the lowest-priced communications receiver includes a switch which silences it during transmission. An additional switch permits cutting out the BFO for radiotelephone reception. Some include switches for shifting between a speaker or headphones; others use phone jacks for this purpose. More elaborate communications receivers include many other features such as automatic volume control (AVC), crystal filters, "S" meters, antenna phasing adjustment, etc. These all constitute refinements which are not essential to ham operation, but which add to the convenience and pleasure of operation. Novices generally content themselves with the less elaborate receivers until after they have attained the grade of general-class amateur. Most of the lower and many of the medium-priced receivers also provide the standard broadcast band, particularly the smaller receivers. This is an advantage when one is traveling, because both portable amateur transmissions and broadcast entertainment can be received with the same receiver. In any event, receivers for amateur use should be of the all-band type capable of covering the 10-, 15-, 20-, 40-, and 80-meter bands. All popular receivers for ham use, except some military surplus types, are provided with this feature. Be sure to choose one that has it.

That just about sums up the requirements for a suitable receiver for the novice ham. Whether his choice is one of the more modest low-priced receivers, the finest he can buy, or a selection somewhere between, is a matter of individual taste. The smaller but entirely satisfactory receivers—factory-built, tested, and ready to go—are available from around \$50 to \$75. Better receivers can be had from \$75 to \$150; still better, from \$150 to \$250, and so on. The finest receivers made—much better than a novice will ever require—are priced in the neighborhood of \$1,500! You'll do all right with a \$50 receiver at the low power you are permitted to use as a novice. Learn to use a simple one first, and then graduate to the more intricate tuning techniques of the higher-priced jobs when you have gained some experience.

USED RECEIVERS

Second-hand receivers represent a rather impressive number of those sold today. Probably the greatest single factor influencing the choice between brand-new gear, or that which has seen previous service, is the cost. Like anything else (ignoring the antique market), a used item will cost less than one fresh from the factory. Look at the used-car market; probably more used cars are sold annually than new ones. There, too, cost is the influencing factor.

It is pretty well agreed that the purchase of *anything* which has seen usage is somewhat like "buying a pig in a poke."

Communications receivers are sold in many ways. New ones of reliable makes are most generally available through your local electronic parts distributors, as well as from reputable mail-order houses. These people *know* that to stay in business and enjoy a good reputation and their share of the potential trade, they must honestly deliver the goods. And they *do!* They handle only the products of reliable manufacturers. No fly-by-night products will be found on their shelves. Ask any "old-timer" among your amateur friends how long so-and-so has been in business and what the local hams think of him. These supply sources will not hesitate to check your credit rating, community standing, etc. It's your privilege to investigate *them*, too, so you may know what kind of treatment to expect.

Check the factory and mail-order house just as closely as you would your local distributor. Your local ham club can tell you if they ever heard of the "Jitterbug receiver" manufactured by the "Jasmine Manufacturing Company." There are some mighty fine, legitimate manufacturers who enjoy not only national but international reputations for the quality of their products and for their fair dealing. The same applies to a considerable number of distributors and mail-order houses throughout the country.

Now let's get back to our discussion of the used receiver itself. Many a ham trades-in his first receiver for a more elaborate one after he has reached general-class status. No doubt you, too, will do the same some day. Ordinarily, nothing in the world is wrong with such a receiver. It gave, and no doubt will continue to give, excellent performance for a long time to come. It was traded in simply because the original owner was eager to take advantage of the additional features a more elaborate receiver would provide. Such a receiver, priced substantially below the cost of a new one of similar type, is very likely an excellent buy and will serve you well during your apprenticeship. But how do you *know* it's a good one? You *don't*—other than the original owner's "say so." That means you must find out who he is. Is he known among the gang as a square-shooter . . . or a sharp-shooter? Try the receiver; if the owner is on the level, he'll be glad to demonstrate it. Take a more experienced ham with you when you look it over. You are bound to run into the occasional "gyp" artist peddling radio gear (a very small minority, thank goodness!). He may even have squeezed through the ham examination, and acquired a license and call letters, in order to legitimize his questionable activities. He buys a set cheap, maybe performs a little "mumbo-jumbo" to make it "hot"

for a week or so, and drops it on you at a bargain (?) price. Here's where experience counts. Many used-car buyers take with them a mechanic whose judgment they trust. Do the same—take an experienced ham with you when you are contemplating purchasing a used receiver. If you don't know one, your local radio club will cooperate . . . you should belong to it anyway.

A very common practice among many ham radio stores is to accept used equipment from local amateurs on consignment. In other words, any ham can leave his equipment to be displayed and sold by the store owner. When and if sold, the original owner collects his money from the dealer, less a small commission for display and handling (usually 10% of the sale price). This is entirely fair—many more people see the gear you are offering (this alone is well worth the small commission) and the store owner is compensated for his display and his effort in selling it. Watch it though—the store naturally cannot be responsible for the condition of the gear. Obviously, for such a small commission he cannot test every item so offered; they must be sold "as is," on the basis of what the owner says. Before you buy something like this, unless you really *know* radio equipment, find out who the owner is. Ask him to let you try it, and take an experienced ham along. Satisfy yourself in every way that you will get full value for your money *before* writing a check or signing a contract. You know what Barnum said—don't *you* be one!

RECEIVER KITS

In recent years, much emphasis has been placed on the "do-it-yourself" fad. Many manufacturers offering products for use in home building and equipping have developed easily assembled kits of parts which have been prefabricated to accurate dimensions. All a purchaser need do is perform the simple assembly operations required. In this way, he ends up with a quality product at a substantial saving. Electronic equipment has also climbed on the "do-it-yourself" bandwagon. Many kits are available, making it easy for a person with no previous electronic experience, and with but an elementary knowledge of hand tools and mechanics, to produce a reasonable facsimile of a factory-built product. The big saving, of course, is in the labor cost of assembly, wiring, and testing. Receivers, transmitters, test equipment, and many auxiliary items are available in kit form. Unfortunately, although the assembly of this equipment is within the capabilities of the average builder, receivers are somewhat touchy. Strange as it may seem, a transmitter for the novice band is infinitely simpler to assemble than a receiver! The following paragraphs will explain why.



One of the low-cost Knight kits assembles into this modest but attractive receiver. While lacking many of the features of more costly receivers, this "Ocean Hopper" will give you many pleasurable hours, and its cost is only about \$17.

For a few dollars more, this "Space Spanner" kit has a few additional features, such as built-in speaker, not included in the "Ocean Hopper."





The new Gonset G-63 is reasonably priced, covers six amateur bands (80-6 meters), and can be used after you have obtained your general-class license.

You can get several added features for an additional \$30 or \$40. Hallicrafters S-107, for example, sells for just under \$100.





Hallicrafters Model SX-110 sells for \$159.95. Not only is it an excellent receiver for the novice, but for higher-class licenses as well.

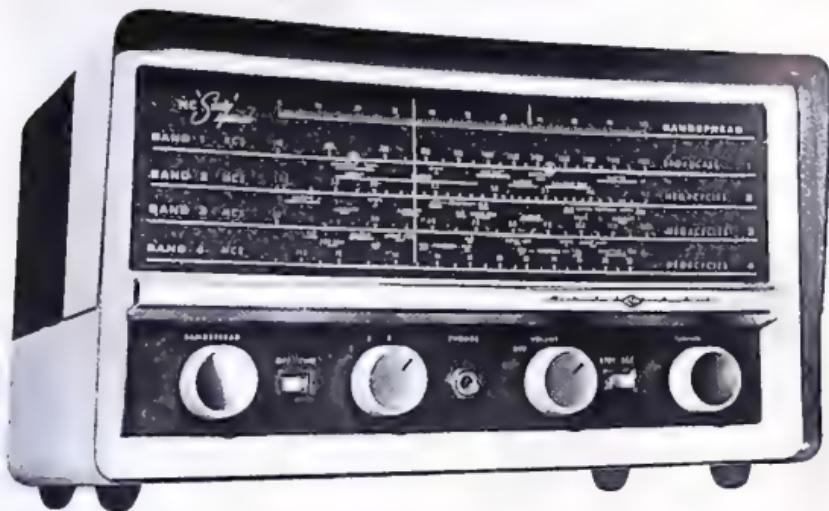
If \$150 is more than you can spare, sacrificing a few refinements will bring the National NC-188 within reach. It has features approaching that of the NC-109, but is priced at \$139.95.





Another excellent receiver in the \$60 price range is the Hallicrafters Model S-38-E. It also incorporates a built-in speaker and easy-to-read slide-rule tuning scale.

The NC-60 Special, made by National Co., receives phone as well as CW, has a built-in speaker, and provides a headphone jack. This unit, including tubes, sells for approximately \$60.



Transmitter parts are generally larger than those used in receivers, and are usually mounted farther apart. Moreover, adjustments are far less complicated for transmitters than for all but the simplest receivers, and the test instruments for the more complex receivers are more intricate, numerous, and costly than for transmitters. In spite of this, a number of *good* receiver kits are available, and several are in the "excellent" class. Nevertheless, most of them require a pretty good foundation in radio principles in order to produce a really satisfactory receiver. Novice kits are available at prices running something under twenty dollars. For the more advanced ham, there are excellent receiver kits costing around \$100, which are the equivalent of \$150 to \$200 receivers in performance—provided they are *properly* assembled, wired, and adjusted. If not, you're in for more than your share of trouble.

The author has talked with a number of factory engineers connected with firms who make such kits, and has corresponded with many more. The consensus of opinion expressed by them is that the novice—with little or no previous electronic experience, few if any of the special alignment tools or test equipment, and a vague idea of what it's all about—is far better off buying a ready-made receiver. A receiver kit is a mighty good way to save a substantial sum and get a good receiver—after you become a general-class amateur with greater knowledge. If you are a "greenhorn," a \$30 to \$100 investment in such a kit will almost always be a loss. Why spend \$30 or so, plus many gallons of perspiration, and then find you must take the kit to a local radio shop and pay an additional \$15 to \$25 to have it properly aligned and adjusted? After all, it hardly makes sense—when you can buy a new, factory-built, wired, and tested job for about the same price. Hamming is a thoroughly enjoyable hobby—why turn it into a drudge?

So, we're going to make this section on receiver kits short. As far as receivers are concerned, it is far better that the novice stick to a factory-assembled, wired, tested, and guaranteed product than attempt to build his first one from a kit. Whether such a factory-built receiver is new or second-hand is of little consequence. The *important* point is that it is already built, circuit components and wiring are correct, and it is properly aligned and adjusted; certainly, in the new equipment it will be. The second-hand ones may be a bit out of line, and some may even have been modified; but if you follow our advice and have an experienced ham friend advise you before you buy, you'll not go far wrong. In almost every instance you'll be ahead not only financially but in operating satisfaction, if your receiver has been built by a reputable manufacturer . . . not by *you!*

MILITARY SURPLUS RECEIVERS

It has often been said that "history repeats itself" at least it *does* with respect to surplus electronic equipment. Shortly after the end of World War I, a tremendous amount of surplus radio equipment was released for sale to the public. Again, after the close of World War II, the identical situation developed and for much the same reason. To put the equipment in "moth balls" was economically unsound, in view of the rapid development and consequent obsolescence of existing equipment. As a result, the surplus market was again flooded with hundreds of thousands of items of electronic equipment, all superbly designed and precision manufactured. Best of all, the World War II equipment, which included thousands of communications receivers and transmitters, often could, with little or no modification, perform splendidly in the amateur bands. To top this, prices were ridiculously low! Although most such equipment was rapidly snapped up by surplus dealers they, with few exceptions, sold it at a reasonable mark-up. This was a boon to the amateur. Receivers and transmitters which originally cost \$3,500 could be had for as little as \$50 or \$75! Some were even brand-new, in their original cartons! Similar items, which had seen some usage, were priced between \$15 to \$35. Test instruments, mobile antennas, and other items too numerous to mention, were readily available at proportionate cost. As a consequence, many amateur-radio stations today boast of such equipment, which is rendering yeoman service, requires practically no maintenance, and made only a very small hole in their owner's pocket! Moreover, ex-GI's will attest to the high quality and the ruggedness of military electronics gear.

Naturally, the surplus market today is pretty well depleted, but by a little judicious shopping, a fair proportion of it can still be unearthed. For example, just recently the writer ran across a Navy/Coast Guard combination transmitter-receiver. It had a dual power supply for 115 volts AC, and all connecting cables and plugs, at a price of \$75 complete with instruction manual! Capable of nearly 100 watts CW input and 70 watts phone, and in perfect condition, it was too good to pass up. As far as can be ascertained, the contract price to the government for this equipment originally was \$3,780! Make your mouth water? Snoop around; you never know where such bargains might turn up. A word of caution though, before you're swept off your feet by a ridiculously low price for such a complicated and intricate, but certainly most serviceable, bunch of gear. Follow our earlier suggestion and take an *experienced* ham with you; let him pronounce it suitable for your use before you lay your nuggets on the bar. Why? Let's see.

Much of this military gear, particularly that used by the Army and Air Force, required "odd-ball" voltages for the initial power source—12 to 14, or perhaps 24 to 28, volts DC. Storage batteries generally supplied these voltages. Sometimes 6-volt filament tubes were used, and sometimes 12-volt. Some were of the straight filament which could operate properly only on direct current; others, by reason of heater-type filaments and cathodes, could use either AC or DC. The 14 or 28 volts DC also powered the driving side of a dynamotor which, on its output side, delivered the 250 to 1,000 volts DC required for the receiver and/or transmitter. An amateur, purchasing such equipment for use with an initial supply source of 115 volts alternating current from his house circuits, is presented with quite a problem. He must either acquire an appropriate dynamotor, or sufficient storage batteries to assure peak performance, or else perform rather extensive modification. Most amateurs choose the latter method, so the tubes can be powered from a standard filament transformer, and the higher plate and screen voltages from a conventional power supply and filter. This is the most economical choice, too. Nevertheless, considerable work is required, much of it demanding a great deal more knowledge of radio and electrical circuits than the average novice possesses. Such modifications *can* be done—in fact, *have* been done, by the embryonic ham—but it isn't easy! True, you'll save a lot by purchasing surplus gear and, properly modified, it will perform beautifully. But again we say, it's going to be a bit rough unless you have a pretty thorough background in electrical and electronic work.

On the other hand, perhaps you were fortunate enough to have served in the armed forces in a position that enabled you to become more or less familiar with some of the electronic communications equipment which later became available on the surplus market. If so, such modifications may not be too much of a problem; time is perhaps the only factor. If you're in that position, go to it; you'll come out with some pretty fine gear for only a relatively few dollars. Again, if you have *no* previous knowledge of this type of equipment, think twice before you decide to purchase it. And by all means, take that experienced ham friend with you. Be guided by what he tells you it will take in time, money, and ability to give you what you want. However, should you be fortunate enough to locate a receiver, transmitter, or both, ready to go, and your ham friend has checked to see that it will cover the bands you propose to use in your novice work and that its performance is up to par, buy it! It will most certainly be a bargain, for it will be priced at least a tenth and maybe even one-hundredth of what Uncle Sam paid for it initially! It all boils down to this; if you find what you want

and what you think you can use in military surplus, and your adviser confirms what you think, buy with confidence.

HOMEMADE RECEIVERS

"Why," you say, "can't I buy a handful of parts for about ten or fifteen dollars, tie 'em to a "breadboard" with a few nails or screws, run a few straggly wires between them, and have a satisfactory receiver?" Well, you *can* receive signals from amateur stations on both CW and phone with such a heterogenous collection of coils, capacitors, and resistors. But we would most certainly question how satisfactory it would be. We previously stated that a receiver is a pretty intricate piece of gear, if you want one that gives you really satisfactory reception (something which will enable you to hear other amateurs maybe a hundred miles away, and perhaps a thousand or more, with any degree of success). You should be able to converse with another station without annoying interruptions from more powerful and nearby stations, from neon signs, interference generated by your own or your neighbor's TV set (oh, yes, they do!), power-line noises, and weak signals. You'll get some interference anyway, even on the best receivers—but a *good* one will greatly minimize it. Really, you're giving yourself a heavy handicap if you attempt to toss a "breadboard" receiver together for "peanuts" and expect to achieve satisfactory reception.

This is not to imply that you *cannot* manage some communication with a modest receiver, laboriously built from scratch. Electronics magazines, as well as numerous manuals, describe the construction of simple receivers. But if you lack previous electronic experience, none of the receivers you will be able to build will give you the performance you can expect from factory-built amateur receivers or kits, or from the proper choice of a military surplus job. You'll get results, of course, but you'll also get frustrations. The major reason such receivers are described and illustrated is to satisfy those who demand economy in their hobby. Although the cost of parts for building a simple receiver is relatively small, it will nevertheless approach the cost of a low-priced receiver kit. The latter, although not all to be desired, ordinarily will outperform your "home-brew" job, and is infinitely easier to build. Furthermore, unlike your homemade set, the kit receiver will have some trade-in value. After you have gained considerable experience and your curiosity bump has enlarged sufficiently to equal your desire to do a bit of experimenting, build a receiver if you want to. It's mighty good experience—but again we suggest that you do so from a kit, not from scratch. Let the factory do the hard work for you, and let their instruction book be your guide. Your pleasure will be greater and your results

infinitely more gratifying, unless you're an excellent craftsman. Buy something you *know* will do the trick; don't gamble at this early stage in your ham career!

SUMMARY

That just about does it as far as the receiver is concerned. To make selecting a receiver a bit easier for you, let's recapitulate a bit. In the first place, you have your choice of procuring a simple receiver which will see you through your novice period, after which you can begin to think of something more elaborate. Or you can get your eventual receiver right at the start. The choice is yours and should be considered from several standpoints. First, whatever you select in the way of a modest, low-priced receiver, if such is your choice, should be something which will insure you a good resale or trade-in value within a year or so, because you will want something better after you graduate to general class. Second, if you have chosen to purchase a modern, up-to-date receiver in the higher brackets, examine *all* the offerings of the leading manufacturers, just as you do when you are shopping for a new car. Although most receivers in the same price group are more or less alike, they do have various features to which you should give some thought. Maybe you prefer rotary-type tuning dials, or perhaps the slide-rule design has greater appeal. Some include "S" meters; others don't. Do you want a crystal filter? AVC? Shop around; don't jump at the first one you see, unless it happens to be just what you are looking for. Third, you have the economic consideration to think of. You and only you know what your budget will stand. If you are one of the fortunates who needn't give much thought to this angle, let only your wallet be your guide. If close and careful budgeting is necessary, your problem is a bit more complex. You can purchase amateur-radio equipment at so much down, so much a month. You can get a brand-new fifty-dollar receiver for as little as \$2.00 down and \$1.00 a week. You can do as well with a higher-priced receiver, if that is your preferred buying method. From this standpoint, no one can advise you; you are the guardian of your purse strings. Just keep in mind that you *still* have to buy a transmitter, antenna material, maybe a key and phones if you don't already have them, a *Conelrad* monitor perhaps, plus minor station accessories such as an antenna switch, call book, log book, and QSL cards! Better not put all your eggs in the receiver basket. We suggest you read this manual right through to the finish before you lay a penny on the line for *any* radio gear. By so doing, you will have a better understanding of a complete station and its accessory equipment, and a more intelligent approach to the procurement problem.



CHAPTER 3

CHOOSING A TRANSMITTER

Transmitters, like receivers, can be broken down into factory-built, kit, military surplus, and "home-brewed" types. All we can do is offer experienced comment on these offerings; the eventual choice is yours. This, as with the receiver, depends on your desires, your construction ability, and last (but usually most important), the size of your checkbook. Let's approach the transmitter problem, then, with all these factors in mind.

FACTORY-BUILT TRANSMITTERS

Your most satisfactory solution to the transmitter problem will be to purchase a standard, well-known make which is ready to go. This type of transmitter has been put through the mill not only by skilled factory engineers and technicians, but also by thousands of amateurs through actual, on-the-air usage. The "bugs" have all been ironed out; the transmitter is ready the minute you unpack it and set it up in your station—if you follow the simple directions in the instruction manual. This "if" is important; there is too much assumption on the part of many prospective novices, who have read a book or two, that they know more than they do! Them's harsh words, we know, but nevertheless they're straight from the shoulder! It happens just a little too often, mainly among the younger group, and it isn't good. There is only *one* way to approach the problem of placing the factory-built transmitter in operation. In the first place, you'll find an instruction book included with the gear. It has a purpose—to familiarize you with the equipment before you even attempt to operate it. It's squarely up to you to read the instructions



This Globe Chief deluxe transmitter is capable of up to 90 watts power input. VFO and modulator are available as accessories, and require no modifications. Cost of the basic kit is about \$60; factory-assembled units run approximately \$20 more.

before commencing with actual installation and operation. If you *don't*, you have no reason to write the manufacturer and condemn his product.

Let's assume you have read the literature. Your problems then are minor; all you need do is follow what the manual tells you about placing the equipment in operation. When you do not come up with a satisfactory result, you can attribute it to two or three reasons. First, you may have "missed the boat" somewhere down the line; in other words, you overlooked something in the instructions. Secondly, maybe you've been a bit overoptimistic in your interpretation of the instructions. And third (we hope not!), you have adopted the attitude that you know more about the equipment than the manufacturer does. Give the design and construction engineers their due by accepting what they tell you. If you *do*, ninety-nine times out of one hundred you will achieve success. But if you try to outsmart them at their own game, both you and the factory are in for headaches! The mere fact that you're a shipping clerk in an electronic factory doesn't give you an edge on the design engineer! You can just about bet that *he* would be just a "dub" in your department.

With these facts firmly fixed in your mind, let's see what the average factory-built transmitter has to offer. There are probably more makes of factory-built transmitters, both in kit and finished form, than there are receivers. Receivers for amateur use, in general, all follow the same pattern, inasmuch as they are simply a means of receiving radiotelephone and radiotelegraph signals. Although there is a wide variety of style, size, weight, and prices, basically they all do the same thing.

Transmitters, on the other hand, offer a much wider field to the design engineer. For example, most novice transmitters, built to operate at the maximum legal input power (75 watts), are of the simple CW type; they are not equipped with modulation apparatus

to permit radiotelephony. Many of these will accommodate a separate modulator unit, often built by the same factory, when you later want to enter this phase of ham operation. Power variation also offers a wide field of design. Although many purely novice rigs are offered, ranging in input power from as little as 30 to 40 watts up to the legal 75-watt limit, the general-class amateur is allowed up to 1,000 watts of input power. Consequently, the demand for transmitters covers a very wide spread. In most instances, the power of your transmitter will be determined mainly by how much you feel you can afford. This, too, covers a wide range. The high-school lad and lassie, who earn their pocket money by running errands, mowing lawns, or babysitting to supplement a somewhat meager allowance, are forced to confine their purchases to something with modest power and not too many "frills." The steadily employed adult, however, usually has somewhat more freedom economically. Nevertheless, should he propose to operate only occasionally, and perhaps only in a few CW bands, neither his power nor his equipment requirements need be large. Then there are those with a bit more affluence, as well as a burning desire to spend a large portion of their time working "DX" around the world, handling hundreds of third-party messages, and working in all of the available CW and phone bands. They will want the best they can buy.

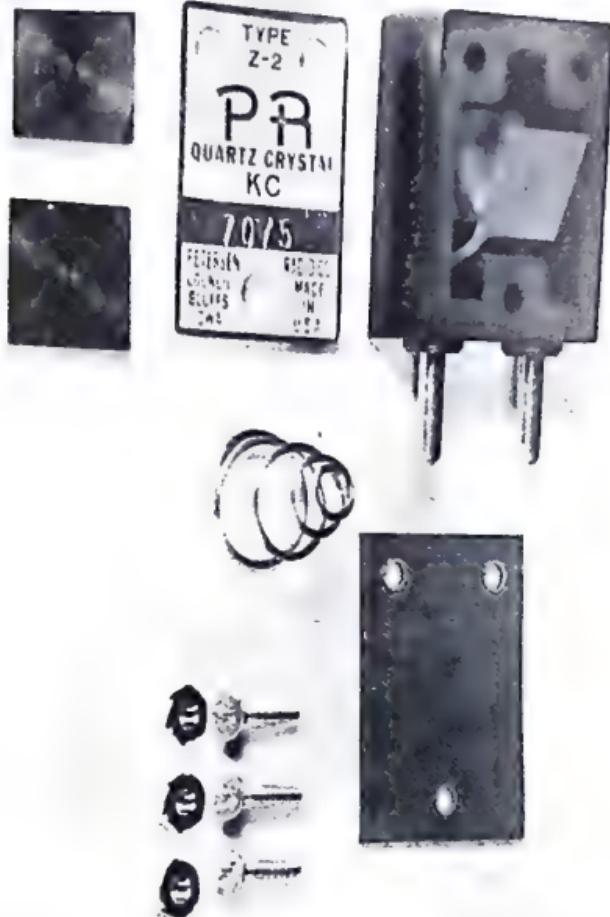
The most popular transmitters, from the standpoint of power, run between 100 and 250 watts. Many excellent factory-built rigs are available in this category. They may also include modulation provisions within the unit, thereby comprising a combination radio-phone and CW transmitter. Costs run all the way from \$100 to \$500 and up; some of the most elaborate ones are priced as high as \$1,000 or more.

In choosing a transmitter, then, you have a number of factors to consider. First, although your novice license limits you to a maximum power input of 75 watts, you may prefer initially to purchase a transmitter with higher input-power capabilities. In this way you can operate at a lower power while you are a novice, and then increase the input after you become a general-class ham. This is easily done; in fact, provisions for doing so are often built-in by the manufacturer. Generally a distinctive mark is placed on the scale of the plate milliammeter to indicate the point you must not exceed as a novice. You can readily adjust the "loading" of your antenna system right on the transmitter panel to assure legal operation. Don't be tempted to sneak it beyond that point, though, until you actually have your general-class license!

Leaving power for a moment, your second decision will be what you want in the way of facilities. Will you be satisfied with a simple



A typical amateur quartz crystal in a dustproof holder. These are offered by a number of manufacturers for around \$3 or \$4.



Amateur crystal produced by International Crystal Co. Although encased in a metal holder, it closely resembles the one shown previously.



CW transmitter to which a modulator unit can be added when you can legally use it? Or do you prefer to purchase a built-in modulator initially, allowing it to remain idle until the great day comes? Either method is entirely satisfactory and practical; an integral modulator within the transmitter will, of course, substantially increase your initial cost.

Next in order of importance, and something which will also affect the cost of the transmitter, is deciding whether you wish to include an integral VFO (variable-frequency oscillator). These are readily available in either the simple CW transmitter or the more intricate phone-CW combination. Or if you prefer, an external VFO can be added when you can legally use one; again, either method is entirely satisfactory. We presume most readers are familiar with the purpose of a VFO. However, for the benefit of those who are just commencing their novice study, let's discuss it briefly.

The law says a novice transmitter must be "crystal-controlled." This means the radiated frequency is fixed at the oscillator by means of a thin quartz crystal. The crystal is sandwiched between two metal contact plates and enclosed in a suitable dustproof holder equipped with prongs. The crystal assembly plugs into a socket similar to a tube socket, or into a special two-hole socket. Such crystals ordinarily are not supplied with the transmitter; they must be purchased separately. Although not exactly a dime a dozen, they are relatively inexpensive. (A good one can be had for about three

dollars.) But get a *good* one—it might save you a citation for off-frequency operation! You are free to choose one for any frequency you like. You may even wish to have several, provided all are within the assigned novice bands. (See Appendix A.) This, then, constitutes crystal operation as defined by federal law. Now let's relate it to the VFO mentioned earlier.

A transmitter is by no means dependent on a crystal for the generation of radio-frequency oscillations, although most manufacturers provide socket facilities for one or more crystals. A vacuum tube, through proper circuitry and supplied with suitable power, is perfectly capable of such generation and is known as a self-excited oscillator. In the crystal rig the frequency is rigidly fixed by the thickness of the crystal, whereas in the vacuum-tube circuit it depends on the circuit constants (values of the coils and capacitors in the circuit). Its frequency can be readily varied by changing these values and may be almost anywhere, depending on the physical size and electrical characteristics of the components. A VFO is, in effect, nothing more than a very stable, self-excited oscillator with a calibrated knob and scale which permit tuning through a wide range of frequencies covering all the amateur bands for which the transmitter has been designed. Without accurate calibration and use by an experienced operator, it is easy for signals to be radiated on frequencies outside the confines of the amateur bands for which the station is licensed. This is why the VFO is restricted to *only* the general class (or higher) amateurs, who presumably have sufficient experience to avoid improper operation. A VFO is a distinct asset when it can be used legally, and you will want one eventually. It permits immediate adjustment of your transmitter to the frequency of the station you wish to call. Today it is common practice for VFO-equipped stations to listen closely to their *own* frequency for replies to their calls. Such replies are possible through use of VFO.

Whether or not you decide to purchase a transmitter with modulation for radiophone already provided and with a built-in VFO, or to acquire both units separately when you can legally use them, depends on you and your budget. If you *do* procure one or both initially, remember that you must *not* use *either* one until your general-class license arrives! Meanwhile, you will remain crystal-controlled—or “rockbound,” as it is familiarly referred to in ham circles.

Other factors will also influence your choice of a transmitter. Perhaps space limitations will dictate the size and weight of some of the major equipment. Perhaps the decor of one manufacturer's offering appeals to you more than another's. You have a rather wide



This Heathkit unit, available for about \$65, is capable of full 75 watts input on CW, and includes a built-in modulator that will provide approximately 60 watts phone input. Provisions are made for three crystals and an external VFO, plus bandswitching from 10 through 80 meters.

Heathkit's "Seneca" transmitter kit, for the ham interested mainly in the two- and six-meter bands, provides 120 watts maximum input on phone, 140 watts on CW.



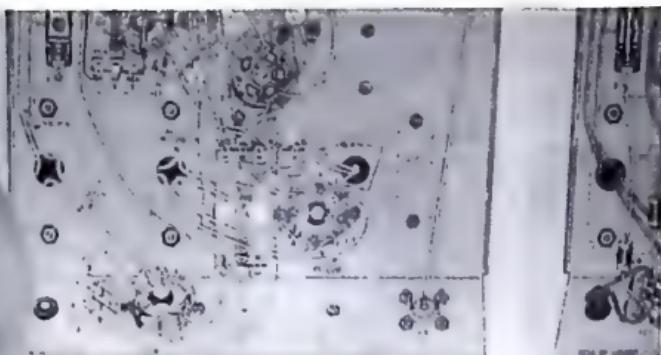


FIGURE 13. FIRST UNDER CHASSIS WIRING VIEW

 knight-kit



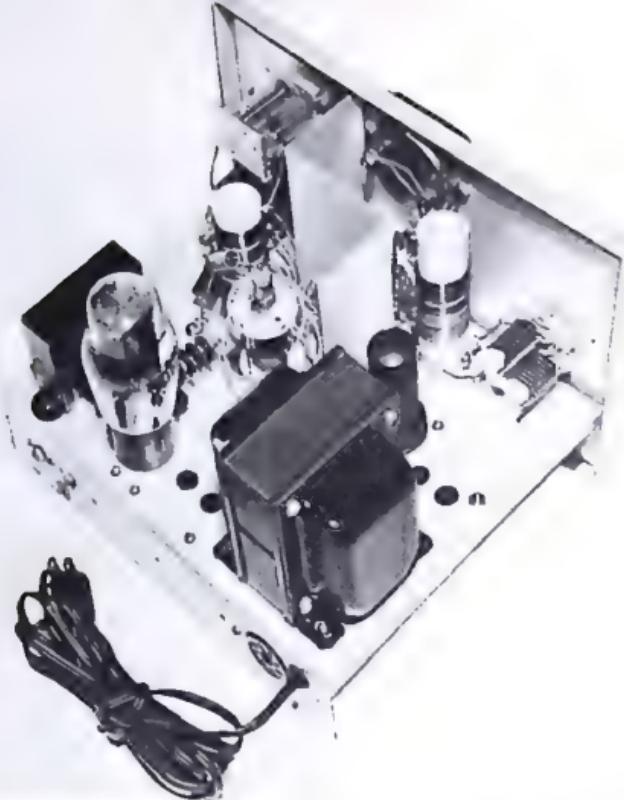
Kit building is fun for both young and old. Here an "oldster" is shown enjoying the soldering process on one of the popular transmitter kits.



The currently popular kit type of construction begins here—unpacking the shipment and checking the various components against the packing list.



The completed transmitter built from the parts shown previously. After making the necessary antenna and power-line connections, followed by a bit of intelligent tuning as outlined in the instruction book, you are ready to communicate with fellow hams many miles distant.



The inside view of a Johnson Viking "Adventurer." Properly wired and assembled, it can't help but reflect the professional appearance of a factory-built job.

Front view of the completed Johnson Viking "Adventurer." A separate VFO and modulator can be added after you secure your general-class license. The unit is available in kit form for around \$55.



Here's a modulator to go with the Johnson "Adventurer," putting it on phone for something under \$12.50. Other manufacturers provide similar units to match their transmitters.



Another transmitter kit for the novice is this Knight-Kit T-50. It is simple to assemble and wire, yet has the performance and appearance of a factory-built job.

This Heathkit DX-20 transmitter kit is also designed for the novice.



choice here, just as it is yours to choose the price bracket in which you want to deal. So much then for factory-assembled, wired, and tested transmitters ready to put on the air.

TRANSMITTER KITS

Contrary to receiver kits—which are excellent for the ham with the test equipment and “know-how,” but a bit on the impractical side for the newcomer to the novice class—transmitters are just the opposite. The very popular transmitter kits in the lower-powered category (40-50 to 90-100 watts), if carefully built, rival the factory job in performance and appearance. All the hard work is done for you: the chassis and panel holes are all punched, the factory finish is sprayed on the cabinet and panel, and the appropriate markings are lettered on the panel face. Every last part required to assemble and wire a complete transmitter is included. Connecting wires are normally already cut to length, and the ends skinned and tinned. Even an adequate amount of wire solder is supplied!

Complete step-by-step assembly, wiring, tune-up, and adjustment procedures are covered in full detail in a generous instruction book. In addition to the clear diagrams in the book, several enlarged ones are furnished which you can hang on the wall while you are working. For the simpler kits which are popular with the novice aspirant, only a most rudimentary knowledge of electricity, electronics, or mechanics is required. You need not be a craftsman in the use of tools; naturally, the more experience you have in using screw-drivers, soldering irons or guns, pliers, and similar small tools, the more workmanlike job you will do. But even the most inexperienced person will produce a substantial and fairly neat job if the factory instructions are followed to the letter. Be guided by the experts, through the pages of the instruction book. Don’t make little changes of your own as you go, in the belief that you are improving the factory design. The old adage, “a little knowledge is a dangerous thing,” is particularly applicable here.

Although the smaller kits in the 40-100 watt category can be readily completed and put on the air by the more or less inexperienced novice, a few words of caution are nevertheless appropriate. You can buy a kit which, in addition to embodying a CW transmitter with provision for crystal control, *also* supplies the additional parts for both a VFO and/or a modulator. Some include just the VFO in addition to the basic transmitter; others only the modulator. We recommend that the novice shy away from either during apprenticeship; they can’t be used legally, anyway! They merely complicate the assembly and wiring (as well as add to the cost), and adjusting and calibrating a VFO is t-r-i-c-k-y—even for an ex-

perienced ham! We know of one ham, with over thirty years' experience both in amateur and professional radio, who tackled a very complete 90-watt job of this type. He produced, of course, a very creditable job which performed splendidly. But he kept track of his time and found that he had spent a total of 108 hours in assembling and wiring the kit. And he *knew* what he was doing! Don't get yourself in a spot like that. If you must have such an elaborate rig to start with, by all means buy a factory-assembled, wired, and tested transmitter!

On the other hand, by poring through the catalogs of various manufacturers, reading the ads in the many periodicals, and examining offerings in local ham radio stores, you'll find that many excellent kits are offered expressly for the novice. These are simple to build, tune, and operate. Moreover, they are within the novice power limitation of 75 watts input, or are plainly marked to indicate the proper adjustment of those of higher power for legal novice operation. The cost of these kits is surprisingly low and the quality of all components exceptionally high, with good safety factors. Somewhere in the price range of about \$35 to \$65 you will get a mighty satisfactory piece of gear, and you'll enjoy putting it together and using it.

The range of choice in transmitter kits is broad. As with receivers, shop around, study the catalogs and ads, and get expert advice from fellow hams (particularly those using the same equipment). All these kits are good; like anything else, individual preference (as well as budgetary considerations) is the major factor in purchasing one. Before we leave the discussion of kits, however, let's make a recommendation that, as a novice or prospective one, you confine your purchase to one in the lower brackets, as discussed in the foregoing paragraph. Your assembly and wiring will be infinitely easier than if you go overboard for a more elaborate kit, unless you have a strong electrical, mechanical, and preferably electronic background. You will gain by so doing, for by the time you attain general-class status, you'll be much more experienced. You'll find, too, that if you've done a good job on your initial kit, your trade-in or resale value will be high. The small discount you must take is a very nominal rental for a piece of gear which has given you so many pleasurable hours during your novice year.

USED TRANSMITTERS

There are just as many good used transmitters available as there are receivers, and there are also the occasional questionable ones. As we said in connection with receivers, by all means take an experienced ham with you if you are contemplating purchase of a

second-hand job. Make sure you buy a well-known standard make, just as we advised you to do in buying a brand-new rig. If the transmitter has been built from a kit, remove the chassis from the cabinet and examine the wiring. Everyone who assembles a kit is not a craftsman, so the job may not look professional. Never mind—it could still perform satisfactorily. Check the soldering, generally the greatest weakness of those who assemble a kit for the first time. Look for "cold" joints, evidenced by a dull, pitted solder joint resembling pot metal. Poor contact will result from this type of soldering. The joint should present a smooth, shiny appearance and show evidence that the solder has flowed into it thoroughly. Check for dirt; a dirty transmitter is pretty good evidence of careless workmanship. A bit of dust is unavoidable; no one will remove "umpteen" screws to wipe the dust from the interior every few days. He *should* do so (and so should you) at reasonable intervals, however, and most certainly before putting it up for sale.

Check the mounting screws and nuts. Have all screws been fitted with lockwashers? They should be. The factories supply a generous number of lockwashers, and in their instruction books specifically mention their installation. Lack of them can also indicate carelessness. Perhaps haste to get on the air was responsible, but it *could* have carried through to other details as well. However, if all components are apparently in good shape and the tubes test reasonably good, it could *still* be a good transmitter with a bit of work. You might have to resolder each joint to make sure of good contact; or remove a nut at a time, drop a lockwasher over the screw, and replace the nut; and you may have to scrub a bit of grease, oil, wax, or other dirt from the chassis. Maybe you'd like to perform these operations, to gain some experience.

Should you decide, on recommendation of your ham friend, that you want the transmitter, even though it will take a bit of working over, you should be able to convince the owner that he should reduce the cost in proportion to the amount of work you will have to put in. He may have already anticipated this and priced it substantially lower than he would, had it been in perfect shape. You and your advisor will have to be the judge. There is little more to be said about used transmitters, whether factory-built or an assembled and wired kit. Much of what we have already said on the subject of used receivers in Chapter 2 is also applicable to transmitters as well. However, this might be a good point to caution you strongly against buying a used homemade transmitter. Although the writer has seen many an excellent homemade job, these were generally in the high-powered bracket, which are simpler to work on because of their size and component spacing. This type of trans-

mitter is out of your class at this time, anyway. It was probably the cost factor which decided the owner to build his own, although we have known some who delight in doing so for their own satisfaction. A "home-brewed" transmitter built by a novice generally does not reflect a great deal of promise, either in performance or workmanship. And seldom if ever can you trade a homemade transmitter in on other equipment—except possibly to another ham, not to a dealer. Stick to standard, well-known, factory-made equipment for complete satisfaction.

BUILDING YOUR OWN TRANSMITTER

Although we warned you against buying a homemade transmitter, there *are* exceptions where a neat, well-performing job must be sold, due to the owner's death, at a ridiculously low figure. Although you can take advantage of a transmitter which will probably perform well for you, be careful. That experienced ham friend who advises you is a mighty fine guy to know, just as he was earlier. In warning you about *buying* a used "home-brew" job, we did not suggest that you cannot *build* one yourself! Such a task isn't much more difficult than assembling an equivalent kit, and will be substantially cheaper. It will take you longer, and you're going to face some hard work in cutting holes in metal panels and chassis. But there are tools for the purpose; they are not too costly and can be used on future jobs. Building from scratch is good experience; you may want to build a novice transmitter, but buy a kit or complete factory rig when you're ready for something more elaborate. Or maybe you would rather build than buy because of the pleasure and satisfaction involved.

However, this book is not intended as a construction manual. Rather, we are attempting to assist you in making a wise choice of your equipment and, in later chapters, how to use it. We will take you through suggestions for arranging your station, choice of antenna, tuning your transmitter, measuring equipment needed, and similar vital subjects. We therefore make no effort to show constructional details of homemade transmitters, receivers, or the like. There are dozens of construction manuals you can buy at your local ham radio stores, and each month many periodicals carry one or more articles detailing such construction. If you prefer to build rather than buy your first novice transmitter, by all means do so, but pick one you can handle. Publications of the American Radio Relay League are particularly helpful here.

If you do decide in favor of building, do a nice job—don't just toss it together. There are more reasons for this than just a workmanlike appearance. Remember, in these days of television, that you

can get in a lot of trouble if you disrupt TV viewing in your neighborhood! This is much more likely to occur with homemade apparatus than with factory-built or kit jobs. The manufacturer has been most careful to provide filtering and bypassing, as well as complete metallic shielding against television interference (or TVI as it is commonly referred to in ham circles). Pay very close attention to everything the construction articles and manuals tell you in this respect, and follow their instructions meticulously. Likewise, learn all you can about key clicks and other spurious radiations. Don't pass up anything on the subject of harmonic suppression either! Building your first transmitter won't be easy, but it will be fun; and if you turn out a successful job from the legal as well as technical standpoint, you'll have many pleasurable on-the-air contacts—as well as the satisfaction of a job well done! Remember, that your trade-in value, if any, will be low!

SURPLUS MILITARY TRANSMITTERS

Don't overlook surplus military transmitters, just as we advised you about surplus receivers in Chapter 2. Very frequently you can find a superbly-built surplus unit which will serve you well, not only through your novice year, but for a long time afterward. Sometimes you will be fortunate enough to locate a complete setup—a transmitter and receiver combination matched in size, appearance, and operating characteristics. These are fine, but there are a lot of "ifs"! Let's list them to make the equipment easier for you to check when you're shopping around. It should:

- Have a 110/125-volt AC power requirement. No modification necessary from this standpoint.
- Cover the frequency bands in which you intend to operate.
- Be equipped with all necessary plugs and cables. (They are pretty difficult to find if not included. Otherwise, intricate modification is sometimes required. Many pieces of military equipment use plugs and sockets which are not readily available.)
- Include complete instruction books and schematic diagrams. This is most important in case of circuit modification for ham usage, as well as for tune-up and troubleshooting procedures.

SUMMARY

It is rather apparent that choice of a transmitter involves many problems similar to choosing a receiver. Intelligent selection of either is often difficult for one with no previous knowledge. This is why

we stressed that, if at all possible, you seek the advice and assistance of a ham who has been "through the mill." We have emphasized the desirability of obtaining instruction books when purchasing military equipment. Actually, this is just as important when buying a second-hand factory-built or a kit-constructed piece of gear. The stress on the military is accented because, unless such a manual is included with the equipment, very often it will be out-of-print or otherwise unavailable. There are a number of conversion manuals which contain circuit diagrams and modification details for many pieces of popular military equipment, but you cannot be *sure* the one you have in mind is covered.

If no instruction book, circuit diagram, or similar helpful data are included when commercial equipment is purchased, a letter to the manufacturer, explaining the circumstances will frequently get you what you want. Sometimes a small charge is made, but the information is well worth the insignificant cost, because it will be of untold help in tuning and adjusting as well as in troubleshooting the set. Manufacturers are naturally interested in having their equipment perform properly, even though no profit accrues to them after the initial sale. It is the good-will engendered by satisfied customers and word-of-mouth advertising that builds their business, even more so than advertising.

Now that we have dealt with the two major items of station equipment, the receiver and the transmitter, let's get on with the several items of accessory equipment. Although not as costly, the latter are just as vital to the operation of the station as the former. Antennas will be discussed in the next chapter. Although, in comparison with the receiver and transmitter their cost is minor, from the novice standpoint they are *really* a vital part of your station. You can generate all the radio frequency you want in your transmitter, but without an antenna of some kind, your communication will be pretty spotty—a few hundred feet, or maybe ten miles. The same holds true with reception; with no antenna, you'll have to be satisfied with picking up just a few local stations!



CHAPTER 4

THE RADIATING SYSTEM

Probably no other single item of amateur-radio station equipment has received as much attention, particularly in recent years, as the antenna or radiating system. We refer to it as a "system," because an antenna alone—without a feeder or transmission line, tuning unit, standing-wave meter, and miscellaneous accessory items—is nothing more than a clothesline or, if vertical, a flagpole. However, the term *antenna*, being shorter and more convenient to use, is generally accepted as being descriptive of the entire radiation *system*. We will frequently refer to it as such in this chapter.

It was discovered, in the late 1880's, that anything metallic was capable of radiating high-frequency energy into free space. Marconi, in 1897, used a metallic cylinder suspended from an outrigger on a tall mast as the antenna for some of his shore stations! We now know that this was a horribly inefficient antenna, particularly when used with the crude spark equipment of the time. Nevertheless, he succeeded in communicating with ships up to a hundred miles or so at sea equipped with woefully insensitive receiving equipment.

Not long afterward, the use of long multiwire antennas, both ashore and on ships at sea, proved enormously more effective. Amateurs of that era followed suit. A conventional, standard ham antenna, from the early 1900's through World War I and for several years following, was of that general pattern. Meanwhile, enormous strides were being made in improving the efficiency of transmitting and receiving equipment. This resulted in steadily increasing the distance the signals could span. Particularly was this true with the advent of vacuum-tube transmission and reception, and somewhat later, the discovery of the value of "short waves." Almost unbelievable distances were being covered by amateurs using modest

equipment of low power and small cost. Antennas, up until then, had been given little thought. True, variations in antenna construction were introduced from time to time, such as the cage and fan types, but all such departures continued to use parallel multiple wires.

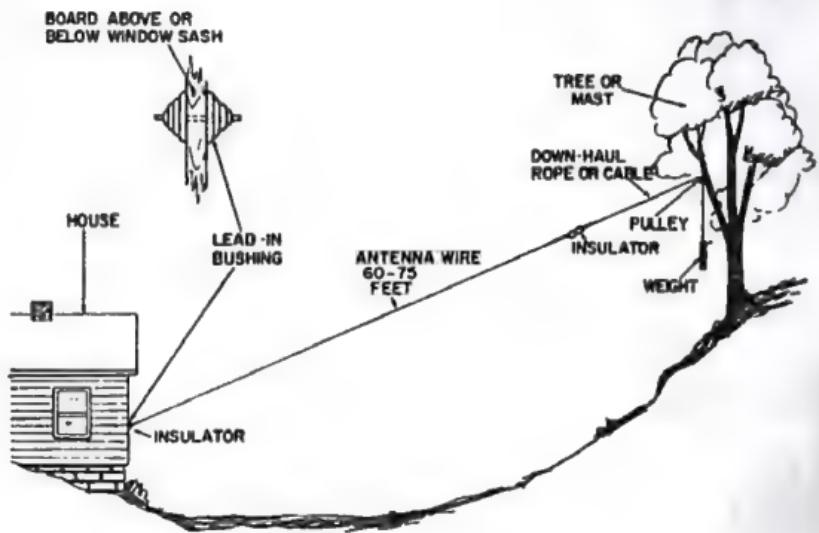
Commercial and amateur research soon led to the discovery that such antennas had entirely too much inductance and capacitance to be really efficient on the shorter waves. The trend was toward merely using a single wire stretched between two supports and fed from one end. Not long after, it was discovered that such an antenna was even better if cut to a length equivalent to the wavelength or frequency being used. Restricted space for the long span often required, soon led to very satisfactory operation with antennas cut to a half, quarter, and even an eighth of the wavelength! Feeding the antenna at points other than at one end, use of two rather than single-wire feeders, and later, use of coaxial and twin-lead feedlines, soon developed. With dozens of variations, these are basically the antenna systems used today by amateur, commercial, and military radios.

Although scores of relatively simple antenna systems are available to the novice amateur, we shall consider only a few of the most popular ones. They can be relied on to produce excellent results for the novice right from the start, their construction being simple and their cost small. Where a mast or pole must be erected to form one or both supports for the antenna wire, cost and labor are, of course, increased somewhat. We will discuss such supporting structures later in this chapter. Now let's consider the antenna system itself.

THE RANDOM-LENGTH WIRE

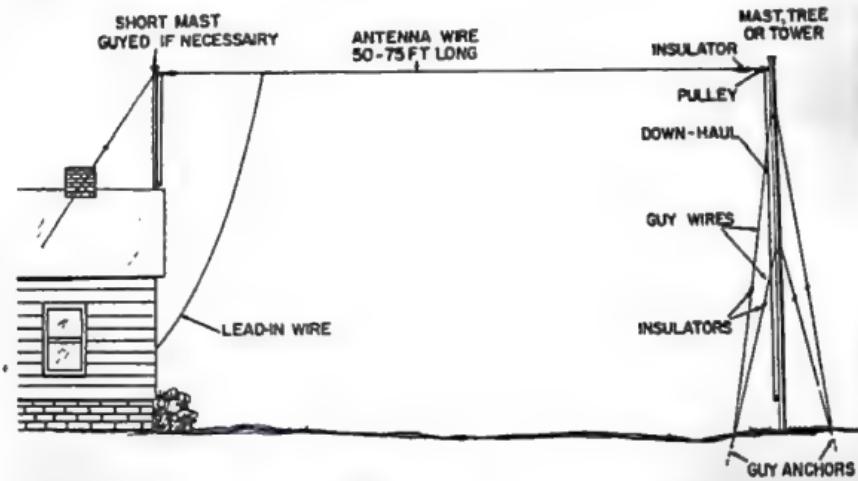
Most manufacturers of both complete transmitters as well as kits avoid much discussion of antennas in their instruction manuals. Statements will appear to the effect that ". . . the pi-output network is capable of matching and loading unbalanced loads between 50 and 600 ohms . . ." This means no *external* matching or loading unit will be required. Later, as your proficiency increases with study and experience, you can give thought to improving your radiation efficiency through use of an external antenna tuner and proper line termination. But in your earlier novice experience, you'll do all right without it. When you are ready to consider something like this, consult one of the numerous handbooks or antenna manuals. For the time being, let's keep the antenna simple.

What we term the *random-length wire* antenna is just that. In other words, its length is determined mainly by the space available



Marconi sloping-wire antenna.

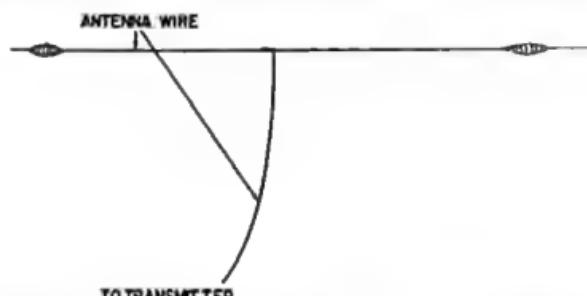
Marconi random-length inverted "L" antenna.



in which to erect it. It can be stretched between two trees or a house and a tree, or masts or other supports can be used if a reasonable distance apart. A good span would be in the neighborhood of 65 feet for the most popular novice bands, 40 and 80 meters. It will also work quite well on 15 meters. It can be longer or shorter, within reason. Somewhere between 35 and 100 feet will also work well, although approximately 65 feet is best. You can even attach the far end to a support 25 to 35 feet above ground, and run the antenna at an angle right down to where it is connected to the transmitter. This, of course, involves no lead-in or feeder and is the simplest antenna you can erect.

Should you suspend the full length of the span horizontally 25 to 35 feet above ground, it will of course be necessary to provide a means of connection to your transmitter. You need merely splice and solder a piece of antenna wire to the end of the antenna closest to your transmitter location, and carry it down to the lead-in bushing. Or if you prefer, you can use an *insulated* wire for the lead-in from antenna to transmitter. Its conductor should, however, be the same size as the antenna wire. This lead-in or feeder forms a part of the radiating portion of your antenna when you use the random-wire, or "Marconi," antenna as it is often called. Your antenna therefore becomes of a length equal to the horizontal span plus the length of the lead-in. Since this type of antenna requires that your transmitter be grounded to a water pipe or ground rod, the length of the ground wire must also be added to the length of the antenna and lead-in. If you have only 35 feet of horizontal antenna and your feeder is, say, 30 feet long, your *over-all* antenna length is 65 feet plus the length of your ground wire. You are not limited to taking the lead-in wire from only one end, in which case you have an inverted-“L” antenna. You are at liberty to connect the lead-in at the center of the horizontal span, thus creating a “T”-type antenna.

For that matter, it need not be at the exact center or end; you can take it off at any convenient place. Here's a point to remember,



Marconi "T" antenna: It is virtually the same as the inverted "L" antenna, except the lead-in is taken from the center.

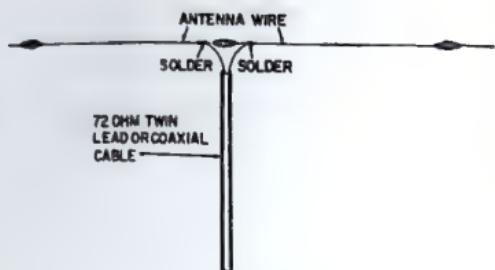
though; should you elect to take your lead-in from the center, the total *electrical* length of the antenna will be the length of the feeder plus only *one-half* the length of the horizontal section! Likewise, if not taken from the exact center, then the *electrical length* will be the length of the feeder or lead-in plus the *longest* portion of the horizontal span, from the point of lead-in connection. Add the length of your ground wire as well, to determine the total over-all length.

THE CENTER-FED DIPOLE

The length of a center-fed dipole is critical because the feeder is no longer a portion of the radiating system, but serves only to transfer to the antenna the energy generated by the transmitter. Although very popular for operation in a single band such as 40 or 80 meters, an antenna cut to length for the 80-meter band will work fairly well on the 40-meter band, but will not approach the efficiency of one whose length has been calculated for this band. This often limits the novice in several ways. First, a newcomer to the ham ranks naturally likes to vary his operation by working on several of the bands permitted him. And he would like his operation on each band to be as effective as possible. The center-fed dipole is not the best antenna in this situation. However, it is possible, the antenna is to be used mainly in the 40-meter band, to also get satisfactory output in the 15-meter band! Operation on 80 meters with a 40-meter doublet, though, will not be very effective, although it will work to some degree.

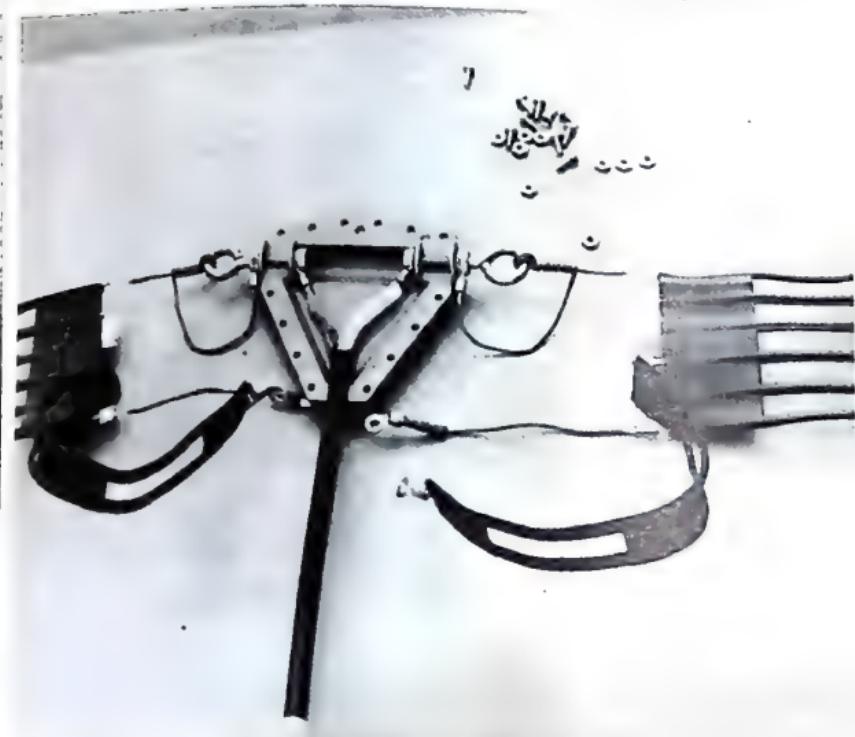
In the foregoing paragraph we mentioned that the actual antenna length is critical for this type of antenna. In order to secure maximum radiating qualities, lowest standing-wave ratio, and best impedance matching between antenna and transmission line or feeder, the antenna length and feeder termination are very important. Such antennas are customarily cut to a half wavelength. For example, you are going to work in your portion of the 80-meter band which, at about the center of your prescribed spread, is 83 meters. This indicates that a half wavelength is about 136 feet long. In cutting your wire to this length, remember to add 16 inches to permit looping through the eyes of the center and two end insulators, and twisting the wire back on the antenna wire. Next, cut your antenna wire exactly in the center, and splice in the three insulators. The radiating portion of your antenna system is now complete.

Restricted space introduces a handicap since a clear area is needed where the total 136 feet of antenna can be suspended. This is of course rather difficult to achieve on an ordinary city lot, but fre-



Half-wave doublet fed at center.

A recent development by Hy-Gain Antenna Products is an all-band center-fed doublet. Constructional details and feed-line attachment are clearly shown.

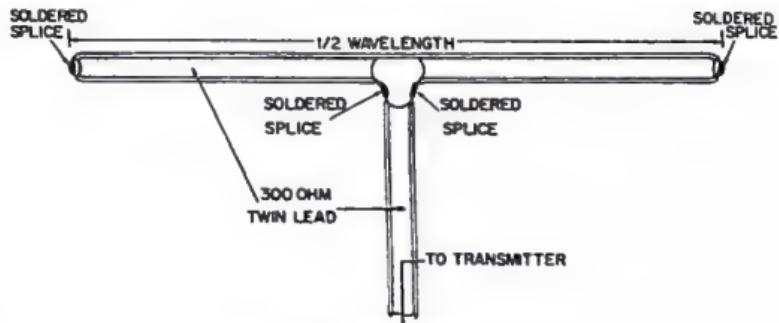


quently a neighbor will not object to your using a convenient tree on his property, or even an inconspicuous roof gable or chimney. Should you find it impossible to find space for such span, you are restricted to either a 40-meter dipole or one of the "restricted-space" antennas we shall discuss a little later. You can also bend the horizontal portion, if necessary, to secure the full 136 feet of span. Such bends should not be more than about 30 degrees. More supports will be required than for a straight span.

The lead-in, or feeder, for this type of antenna becomes what is more commonly called a transmission line, a nonradiating line which carries radio-frequency energy to your antenna in the same way a metal pipe carries water to your house from a street main. Water is confined to the pipe; RF energy is likewise confined to the feeder conductor until it reaches the antenna. Either the flexible twin-lead ribbon line, very similar to TV lead-in ribbon, or coaxial cable of several types can be used. Because the impedance of the antenna is in the neighborhood of 70 ohms, twin-lead or coax with an impedance of 72 ohms, inexpensive and readily available from ham radio stores, provides almost a perfect match. Even 52-ohm line is not too bad, although the more perfect match of the 72-ohm line is preferable. You should experience no difficulty in constructing and erecting a satisfactory antenna system if this type is your choice.

THE "FOLDED" DIPOLE

Another version of the dipole antenna, known as the *folded* dipole, has met with considerable favor in the amateur field. Instead of conventional antenna wire, standard 300-ohm TV twin-lead forms the radiating element. The over-all length of this antenna, like the one described previously, should be one-half wavelength or, for the center of the novice 80-meter band, 136 feet. Only one conductor is cut at the exact center of the antenna, and the ends are peeled back an inch or so to enable connection of the transmission line.



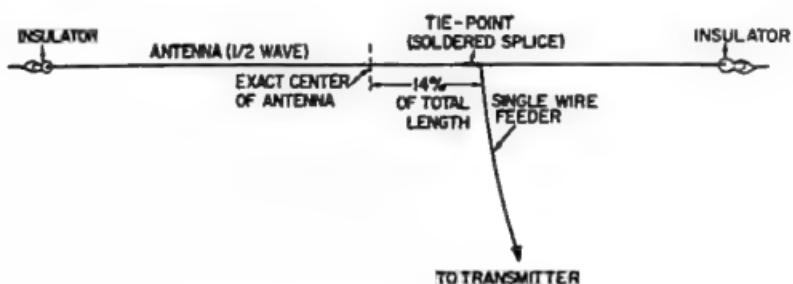
Half-wave folded dipole antenna.

The insulation is stripped from a short section at both ends of the long span, the two conductors are spliced together, soldered and taped well, and fitted with an insulator. The feedline, also of 300-ohm twin-lead, should be spliced at one end to the two free wires at the center of the conductor. To relieve strain from the weight and from wind sway at this point, a short wooden dowel $\frac{1}{4}$ or $\frac{3}{16}$ inch in diameter and about 6 inches long can be firmly taped to the joint. All taped joints should be well varnished to weatherproof the tape, which should be plastic of the type used by electricians. It is usually available in most hardware and variety stores. Manufactured antennas of this type are also available. The center connection is already made, and a feeder line is usually included.

Although an 80-meter folded dipole will show better performance on 40 (and even 20) meters than the center-fed dipole previously described, it cannot be considered an efficient "all-band" antenna. It has the advantage of simple construction, which it shares with the center-fed type previously described, plus a somewhat broader frequency discrimination and less critical length. The cost is a bit higher, of course, for twin-lead than for conventional bare antenna wire.

THE WINDOM "ALL-BAND" ANTENNA

A simple form of single-wire antenna and feedline which performs surprisingly well on 80-, 40-, 20-, 15-, and even in the 10-meter band is the Windom, so-called from the name of the amateur who did a great deal of the experimental and developmental work on it back in the 1930's. Until recently it had gradually become less popular in favor of more recent types, but of late it has seen a distinct revival and is rapidly regaining its former favor. The feeder must be connected to a carefully determined point on the antenna just 14% (.36 of the over-all length of the antenna) from the exact center of the horizontal span. This wire should leave the antenna at right angles and run in a direct line as far as possible before chang-



Windom, or off-center Hertz, antenna.

ing direction. In some areas, the physical layout will not permit this. However, good operation will still be secured, although the antenna will be less effective. For those who are looking forward to all-band operation after they secure their general-class license, the Windom antenna will prove very satisfactory.

"RESTRICTED-SPACE" ANTENNAS

Although the random-length wire is in some measure adaptable to restricted space, it does require supporting structures as well as a large space in which to be erected. It has the disadvantage, too, that the shorter it is, the less effective it will be. Much has been done toward the development of a really satisfactory antenna which would require little area and yet have good efficiency. So far, what appears to be the most practical solution is some form of vertical radiator, rather than the horizontal types discussed previously. Unfortunately, for the lower-frequency bands such as the novice uses, a half-wave vertical antenna would rise to a height of about 125 feet! That, we feel sure, is impractical for 99 $\frac{1}{100}$ % of today's hams! A quarter-wave vertical is an excellent performer, but here again we run into a little structural difficulty—an 80-meter quarter wave would require a vertical wire, rod, or pipe almost 65 feet high! Nevertheless, for those who can raise a metallic radiator to this height, together with the impressive array of guy wires required, it has been a good answer and quite a number can be found throughout the country.

Let's be a bit more practical, though, and consider something by simpler and easier to fabricate and erect. There is little lost by providing an antenna of an *eighth* wavelength in the 3.5-4.0-meter band, which would be in the neighborhood of about 32 feet for the novice. At this height, three light guy wires normally are required, attached about twenty feet above the base and anchored three feet or more from the vertical element at the bottom. If the radiator could be supported its first 15 feet by a wooden post set firmly in the ground or against a house or other building, no guy wires would ordinarily be required for a lightweight radiator such as a TV mast or a couple of lengths of aluminum pipe. Better still, eight or ten feet of the upper portion could well be a standard mobile whip antenna, which are made in these lengths for amateur mobile installations.

Such an eighth-wave length radiator can be fed directly at the base with a 52-ohm coax line; and although a perfect impedance match probably will not be obtained and the standing-wave ratio may be somewhat high, excellent results can be secured. Improved radiation can also be had by inserting a loading coil made of a num-



Vertical antennas are particularly popular wherever space is a problem. This Gotham unit is 23' high, and requires no guy wires or ground radials. With proper loading coil at the base shown, it is capable of tuning all the amateur bands from 160 meters down to 6.



An attractive antenna mast can be made of 15/8" full-round wooden stock. This one, mounted in a "socket" of 1 1/2" thin-wall conduit and secured to a porch railing, is 28' above ground level.

The Gotham vertical antenna beside a garage at the ham station of W4GEI illustrates the simplicity of installation for this type of vertical antenna.



ber of turns of wire, either at the base or in the center of the radiator. Capacity loading is also of value in this connection. It may consist of a light metallic ball (the copper floats in toilet tanks are ideal), or a small aluminum stew pan or circle of wire. These are commonly referred to as "top hats" because they are mounted at the upper end of the radiator. Those interested in such vertical arrangements are directed to the section of this book on mobile antennas, as well as the various handbooks available. We have covered only a few of the simpler types here.

Vertical antennas do not necessarily have to be of the homemade variety. Many manufacturers offer a wide choice, from the simple mast or rod to really elaborate structures fitted with traps (various devices for loading either by capacitance or inductance, and sometimes both), and many other refinements. All are cut to precalculated lengths and adjusted at the factory for the bands in which you desire to operate. Most of these can be classed as "all-band" antennas and will work quite well on multiples of the lowest frequency for which they have been designed. The more elaborate, such as the "trap" type, will perform somewhat better than the simple vertical rod, but will cost more. Complete factory instructions are included, and the antennas ordinarily are shipped in short sections. They present no problem in assembly and erection, and the tuning procedures outlined in the instructions can readily be followed by any novice after a little study. Although opinions vary as to which one is the best, it is a matter of individual choice, based on what you want such an antenna to do, how many bands you want to work, the lowest frequency you will use, and what you feel you can pay. Cost varies all the way from around \$15 to well over \$100. Many of these antennas are carried in stock by your local ham radio dealer and by mail-order houses.

MISCELLANEOUS ANTENNAS

There are almost as many types and styles of antennas as there are hams! (Well, not quite perhaps, but at times it seems that way.) We could mention and describe fixed and rotary beams, both with or without automatic rotators . . . the long-wire (*really* long!) antenna . . . loops . . . inverted V's . . . rhombics . . . a hundred different varieties. Many, like the beams, are designed for specific frequency bands and purposes. As an average novice, you will find most of them a bit complicated to cut your eyeteeth on; and many you probably couldn't find space for. The beams are something for you to consider, after you've gained more experience. Basically, all the antennas you see, hear, and read about have one purpose—to radiate RF energy into free space. The major-

ity of designs are good; there are even a number of freak, or trick, antennas that don't do such a bad job. For your initial efforts, however, content yourself with one of the simpler types until you've mastered some of the theory of radiating antenna systems and the techniques of tuning, impedance matching, etc. You'll get a large measure of satisfaction and be that much better prepared to tackle more intricate radiators as your skill increases.

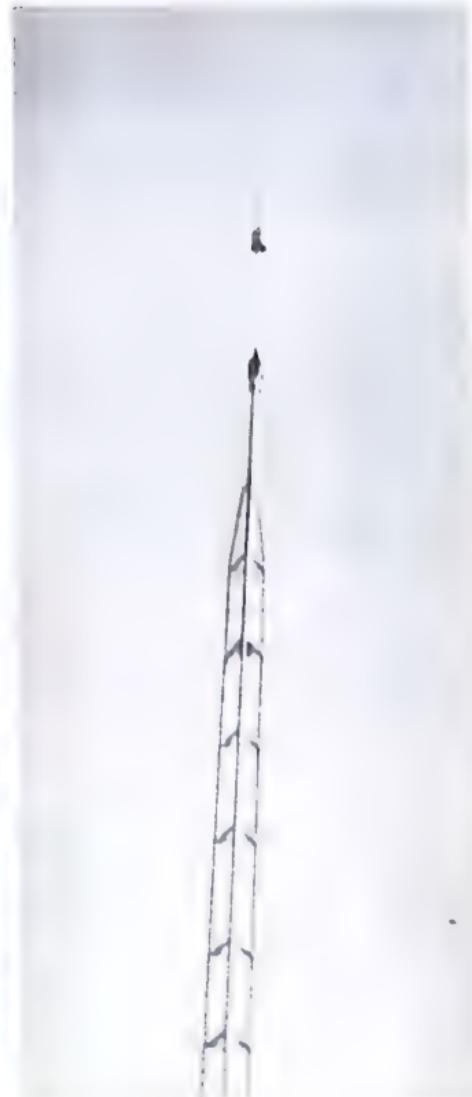
ANTENNA SUPPORT STRUCTURES

If you ignore the beam type of antenna for the time being, you will be concerned only with supporting a wire antenna horizontally, at a height of preferably 30 to 35 feet above ground (at least at one end); or if you've chosen the vertical radiator, suitable base mounting and possibly some guying. Ordinarily the novice takes advantage of suitable existing supports for one or both ends. A heavy screw eye in a house gable can serve well for one end. Although it perhaps is not more than 20 feet or so above ground, you may be able to get the other end up 40 or 50 feet in a sturdy tree, giving you a good, average height of around 30 or 35 feet. If the height is much less, you won't do quite as well—but it will still be satisfactory. Watch the end in the tree, though. Either it must have free play for the downhoist cable, through a pulley block and with an appropriate weight to equalize the pull of the antenna, or you're not going to *have* an antenna when the first big gust of wind comes along. A cast-iron sash weight of the proper size will serve very well. Don't get one so heavy it holds your antenna wire as taut as a fiddle string, though; a slight sag in the antenna is desirable. Play doubly safe and put a fairly strong coil spring between the antenna insulator and downhaul rope; that much more give may save the antenna, should the downhaul or sash weight get fouled some day or the pulley wheel get stuck! A heavy-duty screen-door spring will generally serve well for the average single-wire antenna or folded doublet. If you use a screw eye at the house end and can reach it from the roof or a ladder, you won't need a pulley and downhaul cable. But be sure you can—you may want to take the antenna down some day, without having to call the fire department.

Although a tree normally will serve as a satisfactory support, the writer doesn't favor them nor trust them too highly. Not only is it difficult to calculate wind sway, but often the leaves brush the antenna wire and—particularly during heavy dew or rain—cause leakage. After all, you want your signals to go out in space—not down the tree trunk! A light mast is far better, particularly if you can locate it in the clear. You'll probably have to guy it, but



This 40' mast uses cedar 2 X 4's for the base section and 1 X 4's for the top 20'. Crossarms provide back-guying, and stiffen the assembly considerably. A mobile whip antenna at the top is used as a receiving antenna, and a horizontal half-wave wire antenna is supported from the pulley block at top left.



A steel or aluminum tower will last a long time. This particular one is 40' high and has two telescoping sections which can be cranked up and down or tilted over at ground level. A center-loaded mobile whip is used here, but a pulley block at the top would make it suitable for supporting a horizontal wire antenna.

that shouldn't be too much of a problem. The mast can be anything—a few lengths of iron pipe or conduit, etc. It is possible to buy aluminum irrigation piping in various diameters and in lengths of up to 40 feet. This makes an ideal mast, although relatively costly. Inquire at your local plumbing shop if you are interested.

The above suggestions by no means exhaust the mast possibilities. For several years the writer used a most effective and inexpensive metal mast—a rainpipe, or downspout as it is sometimes called. It comes in ten-foot lengths, and the galvanized type costs around fifteen cents a foot. Three lengths and a five-foot piece of two-inch round or square wood for a top mast gives you a 35-footer for less than five dollars! Paint it before erection, fit a gilded or aluminum-painted copper toilet-tank float ball (or even a wooden croquet ball) to the top, and you've actually got a thing of beauty! A very popular lightweight wooden mast, also very inexpensive, has appeared in the *ARRL Radio Amateur's Handbook* for many years. Known as an A frame mast, it can be built to a height of 40 feet, and can easily be "walked up" by two helpers while you fasten the guy wires. It is light enough to erect on a rooftop, either to the full 40 feet, or less if you wish. Paint it, too, and fit it with a ball for the sake of appearance. There are as many variations in support structures as there are in antennas themselves. Some hams even go to the expense of having the telephone or power company set one of their 40-foot poles for them. These sturdy poles require no guy wires and can be fitted with pole steps so they can be climbed. Cost figures vary widely, but seem to lie between \$35 and \$50 in most communities. Other hams go all out and purchase steel towers, either the plain type or the more elaborate crank-down or tilt types. Sometimes both features are embodied. Their cost generally runs between \$50 and \$100 or so. If guyed, they can be easily climbed also. TV antenna towers are good; so are metal TV masts. Your choice of support for your antenna at one or both ends is almost infinite. Here's a little tip that will save you jammed pulleys and rusted sheaves, or keep your downhaul rope or cable from jumping the track. Don't use a pulley! Instead, pick up one of the screw eye standoff insulators at your local radio store. These have a thick, glazed porcelain insert which provides a smooth, slick surface through which your downhaul rope or cable will readily slide. Screw it into the mast or tree right up to the hilt; it will hold any antenna you will normally use!

SUMMARY

We have given you just about everything you will need to know about an antenna system and its support, as well as many construction and erection hints. From this you should experience no diffi-

culty in building and raising a very satisfactory antenna and supporting masts. You will note that nowhere in the entire chapter did we once mention the receiving antenna, because any antenna suitable for transmitting is every bit as good for receiving. It is common practice for the novice to use the same antenna for both purposes, switching from one to the other. In the vast majority of ham stations this is done manually—flip a switch one way and your transmitter is connected to the antenna the opposite way lets you receive. That is the simplest method. More elaborate installations often use a coaxial relay to perform the switching where coaxial transmission line is used. The relay coil is, of course, controlled by a manual switch at the operating position. Even more elaborate arrangements employ an electronic switch using vacuum tubes. It automatically switches from "receive" to "send" when the transmitting key is manipulated. Don't be too concerned with these relatively intricate arrangements at this point. You'll have plenty of time after you get your general-class license.

There is nothing wrong with using separate antennas for transmitting and receiving, if you prefer. The most elementary random antenna will serve admirably for reception. Twenty-five or thirty feet of hookup wire tossed over a roof or convenient tree limb, even without insulators, will serve splendidly. So will a simple mobile whip antenna from an automobile, or one of the longer whips sold for ham mobile use. Or you can closely duplicate your transmitting antenna, coax or twin-lead line and all, if you want the ultimate in reception! Modern receivers are so sensitive that, as a novice, you'll receive stations more distant than you can possibly work, and the signals will be loud and clear. One precaution, though: keep your receiving and transmitting antennas separated as much as possible and preferably at right angles.

Should you elect to use separate antennas, it will be possible to transmit and/or receive without manually switching one antenna between the receiver and transmitter. Unless you throw the SEND-RECEIVE switch each time you change from transmit to receive, you are likely to experience a "thump" or "blocking effect" in your receiver each time the key is depressed. That is why, in the foregoing paragraph, we suggested separating the two antennas as much as possible, as well as placing them at right angles. This will minimize the RF pickup in your receiver from your own transmitter. To play perfectly safe, however, connect a $1\frac{1}{2}$ -watt neon glow lamp across the receiver antenna and ground terminals, to prevent the heavy surge currents from damaging the front-end of your receiver. These lamps are known as type NE-2 and sell for about ten cents each. They will not affect the volume of received signals in the

least, but will pass any excess RF to ground rather than allowing it to pass through the front-end receiver coils.

CHAPTER 5

MISCELLANEOUS EQUIPMENT

In previous chapters we discussed the major items of station equipment for the novice—receiver, transmitter, and antenna. By themselves, these three items do not comprise an operating novice station. Although the receiver is ready to go when fitted with an integral speaker and connected to the antenna, the transmitter will require a few auxiliary items. Likewise, if the receiver has no built-in speaker, an external speaker or a pair of headphones will be needed to make the signals audible to the human ear. Suppose we dispose of the receiver requirements first.

SPEAKER

Normally, receivers in the lower and intermediate price groups include a speaker within the cabinet. If so, the signals will be audible, like those from a broadcast receiver, and all you have to do is connect a suitable antenna and source of power (ordinarily, a wall outlet in your house-wiring circuits). But if a speaker is *not* integral with the receiver, one will have to be provided. In such cases, it is necessary to know the proper voice-coil impedance for most effective reproduction. However, since such impedances fall within a very narrow range, practically any permanent-magnet speaker will perform satisfactorily. So this is not a vital item, although the instruction manual will generally specify the impedance which will deliver optimum results.

The next most important consideration is the physical size of the speaker. Normally, a speaker is rated in inches, designating the approximate diameter of the cone. In determining which size to buy, you need be concerned only with the method of mounting it—in a separate cabinet, in a wall or desk—and the space available.

Remember that a communications receiver is used only for reception of CW code signals or the spoken voice (radiotelephone), and that you are dealing with audio frequencies in a very restricted range, compared with reception of musical entertainment from a broadcast receiver. The highs and lows of human articulation do not begin to approach those of the musical scale. So, since you are *not* faced with a problem of high fidelity, you can use a small, inexpensive speaker. On the other hand, should you wish to use your communications receiver for reception of broadcast entertainment (assuming it includes the broadcast band), or if you want to listen to short-wave broadcast entertainment, a speaker somewhat larger than the minimum three-inch unit will give better reproduction over a wider scale.

Let's assume you are an average ham. Most of the time your receiver will be used for CW and voice reception; occasionally you might like to listen to a special program of entertainment from the short-wave or standard broadcast stations. The larger speakers will give you better audio-frequency response in the latter instance. The average ham, with this thought in mind, generally selects between a 5- and 8-inch speaker. There is not much difference in cost; most speakers in the 3- to 8-inch range cost less than five dollars. Unless you are restricted in the mounting space available (as in a station control unit, for example), procure one of the larger sizes. The 6-incher is most widely used, although many of the 5-inch sizes also give excellent reproduction. Some hams prefer to go a bit farther and procure an 8-inch speaker, which can be had for around five dollars, give or take a few cents.

The speaker described in the foregoing paragraph is an uncased item. Laid on its back on your operating table, it will be perfectly workable—but lacking the benefit of a baffle, its tone will be of rather poor quality. Such a speaker should be enclosed in a cabinet of either metal or wood. Metal speaker cabinets, already punched and with an attractive grille built in, are available at your ham radio store. These not only will improve the reproduction qualities of the speaker, but will enhance its appearance by taking away the "raw" look. Lining these cabinets with some fibrous board such as *Celotex* (available at any lumber yard or building supply house) will further improve the tonal quality. Wooden cabinets are also available at most ham stores. They have about the same tonal quality, without lining, as a metal cabinet does with it.

The majority of receiver manufacturers whose product requires external speakers also offer a matching cabinet-mounted speaker of a size and finish to harmonize with their receivers. Moreover, the speakers perform most efficiently when used with their own equip-



This factory-built and encased speaker matches the Knight Kit R-100 in appearance and electrical characteristics. Other manufacturers offer similar matching speakers to be used with their equipment.

ment—but they cost considerably more than a “raw” speaker, even with a metal or wooden cabinet added. Actually, you will detect little if any difference in the reproduction of amateur signals.

HEADPHONES

Head telephone receivers, or “headphones” as they are more familiarly called, consist of two telephone-type receivers, usually in a Bakelite case resembling an oversized pill box (generally re-

A set of 2,000-ohm headphones, of the type generally used by hams, sells for approximately two dollars.



ferred to as a *watch case*). Two of these watch cases are mounted in horseshoe-shaped metal rings, and the rings are attached to one or two metallic bands, usually fabric covered, that pass across the top of the head and hold the receivers firmly against each ear. Adjustments are usually provided to fit the different sizes and shapes of the human head. A Y-shaped cord connects the headphones to the receiving equipment.

Headphone receivers of this type have a considerably higher resistance or impedance than those used in ordinary land-line telephone equipment. The most popular are rated at 2,000 ohms, the recommended rating for amateur service. Headphones have several distinct advantages, particularly for the novice, over a speaker. First, by acting as "earmuffs," they assist greatly in concentration by blocking out room noise and other extraneous sounds. Second, no one other than the wearer can hear the signals, which eliminates annoying other people. Third, weak signals are much more readily interpreted, since they are poured directly into your auditory canal. It is often said, particularly by those unused to wearing them, that the headphones produce "corns" on one's ears! Sure, they may seem a bit heavy at first, and the pressure may be somewhat uncomfortable. But it won't be long until you become accustomed to them. And you'll be glad you did.

The ideal setup for any amateur, novice or advanced, is to use headphones *and* a speaker (but not simultaneously, of course). For example, the writer does considerable CW operating (the same would apply to phone) on what are known as *traffic nets*, meaning that third-party messages are relayed between a group of stations at predetermined times. A net control station directs this traffic and indicates which stations are to work with each other. Not knowing when I may be called, I merely leave the speaker in operation until I receive a call, and then shift to the headphones and handle the communication. It's easier on the ears! Another example, again from my own operations. My shop is adjacent to my radio shack; often, while working around the shop, I leave my receiver in operation on the speaker, at a low but readable volume, and tuned to one of the calling and emergency frequencies. (You will learn more about this in Appendix B.) Should a sudden emergency arise or some other station want me for any particular reason, a short call on the C & E frequency brings me right to my gear. This, in effect, makes your speaker your standby, and puts you on practically continuous watch while in the vicinity of your shack. Arrange to buy *both* headphones and speaker, if you can; but if you must choose between them, the 'phones are of course more practical for the novice.

HAND TELEGRAPH KEY

This section is devoted only to hand telegraph keys for a reason. Although there are numerous automatic and semiautomatic keys (the latter more commonly referred to as a "bug"), we want to caution you right at the start to *forget* about them at present! There is no easier way to murder the radiotelegraph code than to place a "bug" or an automatic electronic keyer in the hands of someone not adept in its use. Until you have mastered the basic hand key, do not even think about the more advanced devices. And when you *do*, think *twice* before you get one! If, after careful second thought, you do procure one, don't go on the air with it until you've put in many hours of concentrated practice. "Bug" and automatic keyers are wonderful when operated by competent operators. But pity the poor operator who must listen to the transmission of a beginner from these high-speed devices. Chances are he will drop you then and there, and shun your frequency in the future! Stick to developing a *good* "fist" with the reliable hand key. Then, when learning to use one of the ritzier keys, make up your mind to put in as many (if not more) hours before making a single dot on the air!

When we say hand key, we refer of course to the same hand-manipulated switch developed by Samuel Finley Breese Morse, inventor of the telegraph. Such a key, with minor improvements, is found in 95% of today's amateur stations, regardless of any other fancy keying devices they may have. It is the old standby . . . the "workhorse" of wire telegraphy as well as radio. Every operator, whether wire or radio, amateur or commercial, *must* be able to use a hand key. The sign of a good operator is generally perceptible by his "fist," the term for character formation on a hand key. The hand key is the *only* type you are allowed to use in your FCC novice amateur examination; for that reason alone, you had better know how to work it. Excellent new hand keys can be bought at most electronic parts distributors for around three dollars. Imported keys, but of cheaper quality, are available at half that price or less. Military surplus keys (they are also excellent) often are available in the neighborhood of one to two dollars. Whatever you do, get a *good* key; you'll learn to send better and faster if you do.

CRYSTALS

The crystal is the heart of your whole novice station! United States radio laws definitely state that novice transmitting equipment must be crystal-controlled. You should know by now what a quartz crystal is, and how it is mounted in its holder and connected in the circuit.



Semiautomatic sending key, or "bug," made by E. F. Johnson Co. is something you can look forward to when you are really an operator!



Another semiautomatic sending key, the Martin "Vibroplex."



Hand telegraph keys come in various styles, but basically all are alike. These are made by E. F. Johnson Co. and sell for about \$2 or \$3.

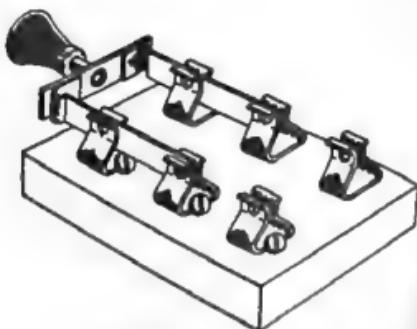
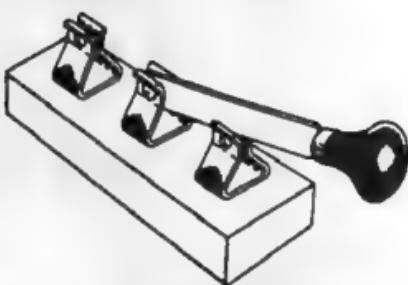
(If not, review Chapter 3.) In addition to giving you a brief description of a piezoelectric quartz crystal, we told you that reliable crystals, properly mounted in a holder and ready to plug in, could be had new for about three dollars. A used crystal, if of a reliable brand, can pretty generally be trusted also, provided the former owner has not tampered with the holder. Such crystals should be checked against a known standard, to make sure they oscillate freely and reasonably close to the frequency with which they are marked (and well within the band limits for novice operation, for certain). Such a check is best performed by a ham with a VFO (see Chapter 3), provided it is accurately calibrated. Homemade crystals ground to the proper (?) thickness by some other ham, you'd better shy away from. Some hams are adept at this art—but most are not. Military surplus? Originally they were of high quality and very accurate in frequency. Be careful, though; the former owners may have tampered with them, and this *could* get you in a jam. Follow the same procedure for checking them as you would for the used crystal described earlier. Be *sure* of *any* crystal you buy. And be sure to buy enough, if you plan to work on a number of frequencies or bands—you'll need one for each *frequency*.

CLOCK

Perhaps it seems a bit strange that such a simple thing as a clock should find a place in these pages. Not exactly; FCC requires you to keep a log, or diary, of station operation. The time each conversation starts and finishes must be entered, along with the date and other pertinent data. (However, you need not enter the time of each individual transmission during this conversation.) What about a wristwatch? It will serve satisfactorily, if you wear it all the time while operating. A cheap alarm clock, if it keeps reasonably good time, will also serve. In any event, a station clock of some kind which will keep pretty accurate time is a *must*. Some hams, like the writer, build them into a piece of station equipment. Others have a low-priced but accurate wall electric clock. Any reasonably good timepiece will do—just make sure you do have one.

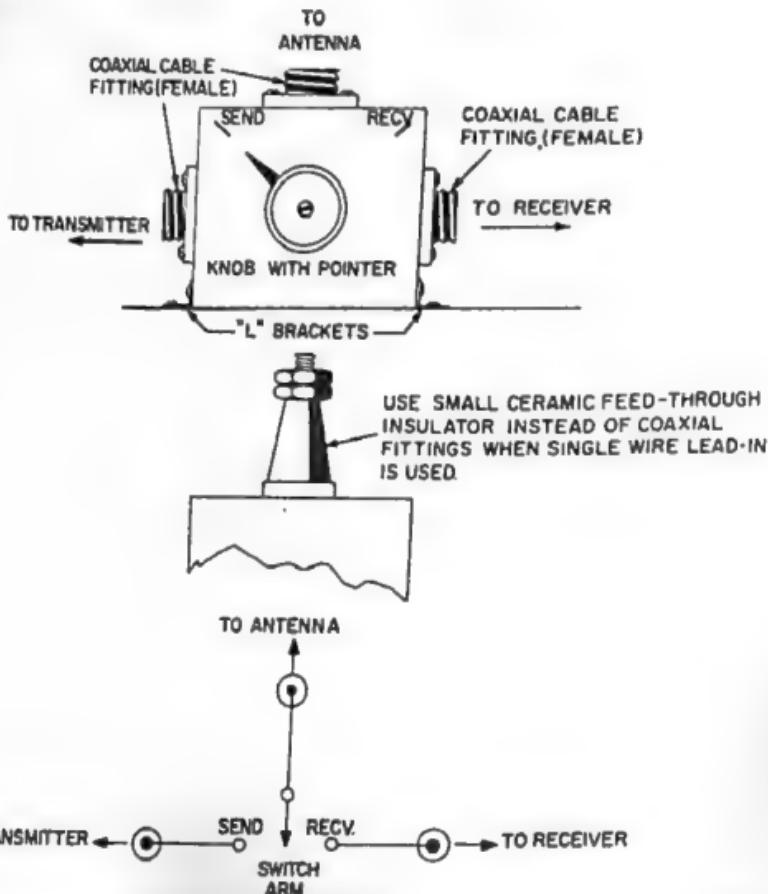
ANTENNA SWITCH

Remember, back in Chapter 4, that we mentioned a small manual switch with which to change the antenna between the receiver and transmitter? Actually, this is a most simple device. The switch recommended for this purpose is a small, porcelain-base knife type, sometimes called a *battery switch*. It is readily available at most hardware and variety stores, as well as at your radio dealer. You will want the type known as *single-pole, double-throw* if your antenna



A single-pole, double-throw knife switch will serve nicely for switching your antenna from "send" to "receive" when a single lead-in is involved.

A double-pole, double-throw switch should be used with a two-wire feed line.



A safe, convenient, and attractive antenna junction box and switch can easily be made from the above plan. A metal cabinet about 2" X 2" X 2" will house the rotary two-position switch. The rotary switch should be the ceramic wafer type having one deck or wafer, an arm, and two contacts.

feeder or lead-in is a single wire. If it is coaxial cable or twin-lead, get a *double* pole, *double* throw. Don't get one with a fibre base, because it can leak RF. Molded Bakelite is better, and one with a glazed porcelain base is best. If you want to test your construction ability, you can build a neat antenna junction box containing the switch. You won't need such a switch, of course, if you are planning to use separate transmitting and receiving antennas.

MICROPHONE

At the outset of your amateur career, a microphone may be a doubtful item of station equipment. Remember that as a novice you can use radiotelephone in the 145-147 megacycle band only. Furthermore, it is pretty doubtful whether you'll find any factory-built or kit-type transmitter or receiver in the novice range that will permit operation in the other bands open to you for CW and also work in the 145-147 mc band. (We know of none.) Neither will you have much success in building from scratch to cover such a wide spread. For the 145-147 mc band, you *can* buy or build a transmitter; but it will not be capable of operation on the lower-frequency bands. In other words, if you want to work CW and radiotelephone as well, you'll need two separate transmitters! What's more, you're going to face the same problem in receiving equipment. Unless you are expecting to concentrate your operations exclusively in the 145-147 mc band—for which there are many excellent receivers and transmitters available, but they will not operate in the low-frequency bands—you're facing a problem. It hardly makes sense to suggest *two* complete stations, one for the lower-frequency CW bands and another, with its separate antenna system, for the ultrahigh frequency band! You *can* buy a converter which connects to your lower-frequency receiver to permit you to hear the 145-147 mc stations—but without a separate transmitter, you can't talk back! And what fun is that?

If you *do* plan most of your operation in the 145-147 mc band, you're far better off to purchase one of the standard factory-built transceivers. These combine the transmitter and receiver in one cabinet and are usually fitted with a telescopic whip antenna. Your operation will be limited to that one UHF band, however, until you attain your general-class license! Of course, you can still *build* a suitable transmitter and receiver, or even a transceiver, for this band from various handbook and magazine descriptions. As a novice, better you don't; they are tricky! If you do, however, you'll need a microphone. The instructions will specify the proper type. A factory-built transceiver will usually include a microphone, or the accompanying instruction book will specify the most suitable types to be used with the unit.



Microphones may take a number of forms and shapes; however, all serve the same purpose.

Maybe you hadn't even considered a low-frequency set of equipment, merely radiotelephone operation in the 145-147 mc band. If so, you apparently have no aspirations for a general-class license and should really be preparing for the technician license, which is outside the scope of this book. A technician license is issued for five years and may be renewed indefinitely every five years without examination. Initially you will have to pass a theoretical examination equivalent to that of general class, *but* you need never increase your code ability beyond the five words per minute specified for novices. On the other hand, you must pay for this indulgence in code speed; you will be restricted to the ultrahigh frequency bands, and may never operate in any of the popular lower-frequency bands such as 10, 15, 20, 40, 80, or 160 meters! Think it over, and if this is your goal, consult a book devoted to preparing you for the technician class of license.

There is one more good reason why we recommend forgetting the radiotelephone idea until you become a general. You procured your novice license by qualifying at a code speed of only five words per minute and an elemental knowledge of a few radio and electrical principles, plus some legal angles. For a general-class license, the code speed requirement is *thirteen* words per minute (plus a comprehensive theoretical examination). If, after securing your novice license, you immediately go on 145-147 mc radiophone, what will happen to your initial five-word-per-minute code speed? Occasional CW operation with other novices isn't going to keep it up; most certainly it will not *increase* it! So, should you decide to take the general-class examination, what chance do you have to meet the 13-wpm requirement unless you ride your code-practice equipment to death? No, it's much better to go through the normal procedure of becoming a novice, continue your study until you can pass a general-class examination, and then enjoy *all* the privileges and *all* the bands open to you. Think it over!

CONELRAD

We have purposely left CONELRAD as the last item of miscellaneous station equipment, in order to get the more minor but nonetheless essential items out of the way. CONELRAD is serious and should be taken so. Not only is it a vital part of our Civil Defense organization, to which you could conceivably contribute some day, but it is a *legal* requirement that you participate as a United States amateur. Unfortunately, too many amateurs, particularly in the novice ranks, ignore this FCC requirement since it involves only the receiver, which is impossible for the FCC to monitor. Nor can their small staff inspect every amateur station to insure compliance. We

can be thankful that only a small minority adopt this attitude which, in addition to being illegal, is completely un-American. Cost of compliance can be most negligible—in fact, completely cost-free, since suitable equipment is often on hand.

What is CONELRAD? It is a federally-devised method of immediately alerting the nation, either wholly or in part, in case of a national disaster such as an enemy attack or an air raid. This is done through previous arrangement with United States and some Canadian broadcast stations whereby, upon notification by FCC, CONELRAD alert warnings are immediately broadcast. Any programs in progress must go off the air and remain off during the alert. The regulations require *all* (and that *means* all, regardless of class) radio stations to cease operation. As you probably know, with modern electronic direction finders it is no trick for an enemy plane to pinpoint any radio station he may hear, and fly in a direct line to that point. Such tracking devices can be trained on *any* type station, including amateur. Let one lone amateur who has missed the CONELRAD alert continue operating, and the results could be disastrous! Say he is in Philadelphia. The enemy pilot can easily ascertain the location of the station through call books which he would undoubtedly carry, tune in on the station, and make a beeline for that city. In a matter of minutes he can arrive directly over it, regardless of visibility, and unload his bombs. Now you see why it becomes your legal, moral, and patriotic duty to take CONELRAD seriously.

Let's see what you need do to comply with the CONELRAD requirement. Every ten minutes (as specified by law), listen to any standard broadcast station, local or otherwise, for a few seconds—just long enough to determine whether it is on the air. If so, you are in the clear until another ten-minute period has elapsed, at which time you must repeat the procedure. Should the broadcast station be off the air, tune immediately to one or two others within your normal range. If they, too, are silent, immediately stop all of *your* transmission. Tune immediately to 640 or 1240 kilocycles (the CONELRAD frequencies for Civil Defense and other important messages). We suggest checking several stations first, in case equipment trouble has caused a station to discontinue operation even though no CONELRAD alert has been declared. Remain tuned to or frequently check the broadcast frequencies, until the all-clear announcement. Resumption of normal broadcasting indicates that you, too, can resume transmission. Until such time, though, *you absolutely must not transmit a single dot!*

There are many ways to accomplish such monitoring. If a standard broadcast receiver is within your shack or close by, play it at

low volume, and listen every ten minutes to insure yourself that it is still on. If broadcasting has ceased, follow the procedure outlined in the previous paragraph. Using your own communications receiver is sometimes awkward because you will probably have to shift the bandswitch and tune the BC station in before returning to a possible interrupted contact with some other novice station, but it is entirely acceptable. A better and really inexpensive way is to pick up and outdated broadcast receiver from a pawnshop or one of the salvage agencies such as Salvation Army, Goodwill Industries, Volunteers of America, etc. (One can often be picked up for a couple of dollars.) Although not much in the way of a broadcast receiver, it will bring in stations within a short radius (after a little tinkering). You can keep it in your shack, at a low enough volume not to bother your normal operations. Every ten minutes, merely turn the volume up and take a check.

Better still, you can modify these receivers slightly to indicate visually on an "S" meter whether the BC station is on or off the air. If the meter indicates zero when you cast a quick glance at it every ten minutes, check the BC station audibly by running the volume control up. Even better, various modification articles will tell you how to fit a relay and buzzer circuit to the receiver, so you won't have to watch the meter. When the BC station fails, the buzzer will sound. A number of CONELRAD alarm receivers, from \$12.50 up, are also available in both kit and completely-wired form. (Additional information on CONELRAD will be found in Appendix C.)

CHAPTER 6

ARRANGING THE STATION

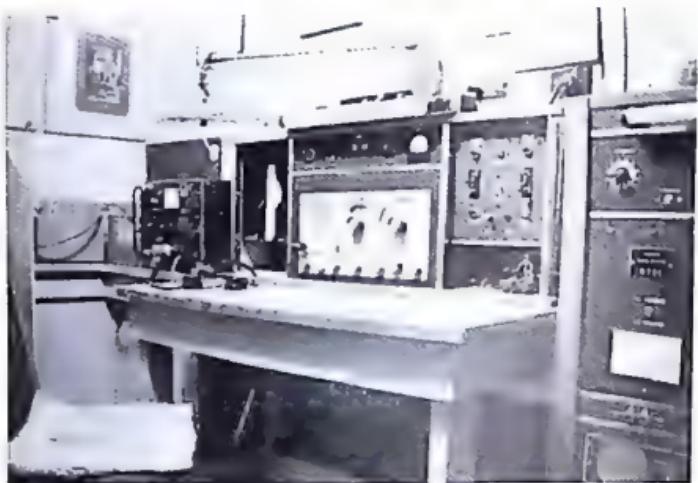
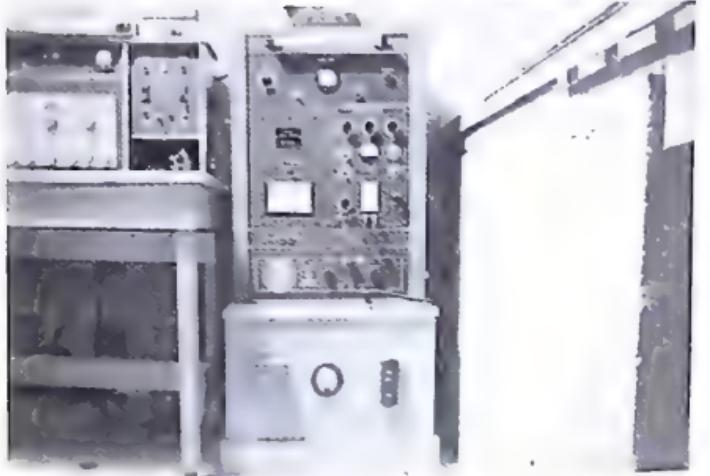
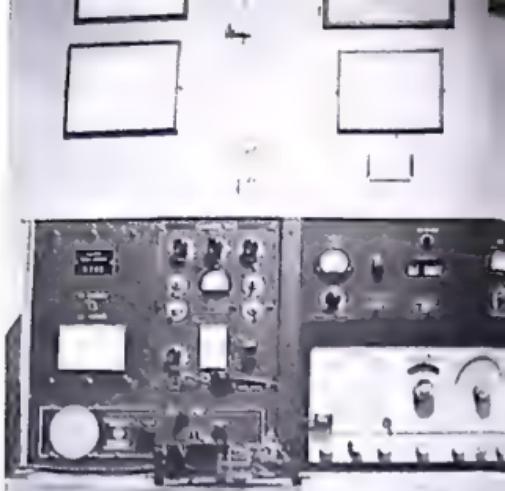
After procuring the essential items of equipment with which to put your station together, you must provide sufficient space to accommodate a table large enough to hold the equipment, a bench or desk, a chair, perhaps a typewriter and stand, and sufficient room to move around. Space is sometimes a problem, especially with apartment dwellers.

Attics or dry basements can be quite attractively treated if unfinished. A little knack with hammer, nails, and saw can produce a small enclosed room which can be lined with inexpensive wall-board and tastefully painted. The greatest cost is labor, but it is worth the effort if you intend to remain a ham. Some hams are fortunate enough to have a small outbuilding they can take over for their ham shack. Others have successfully partitioned off one end of their garage. An outbuilding or garage will, of course, require some method of heating. Because such shacks are generally small, electric heat seems to be most in favor. Except in extremely cold climates, most shacks can be kept at a comfortable temperature with a fan-type electric heater, nominally rated at 1,320 watts or thereabouts. The writer, for example, living in a relatively mild climate, uses a one-kilowatt strip-type heater with no fan. No trouble is experienced in maintaining a comfortable room temperature in the six-by-six shack, even in the coldest weather. Adequate ventilation should also be provided to avoid becoming sleepy. You cannot ham half the night in a hermetically-sealed cell!

LIGHT AND POWER

Lighting, too, is important. Don't strain your eyes by using a dim overhead bulb. Either use one of adequate capacity, or a small

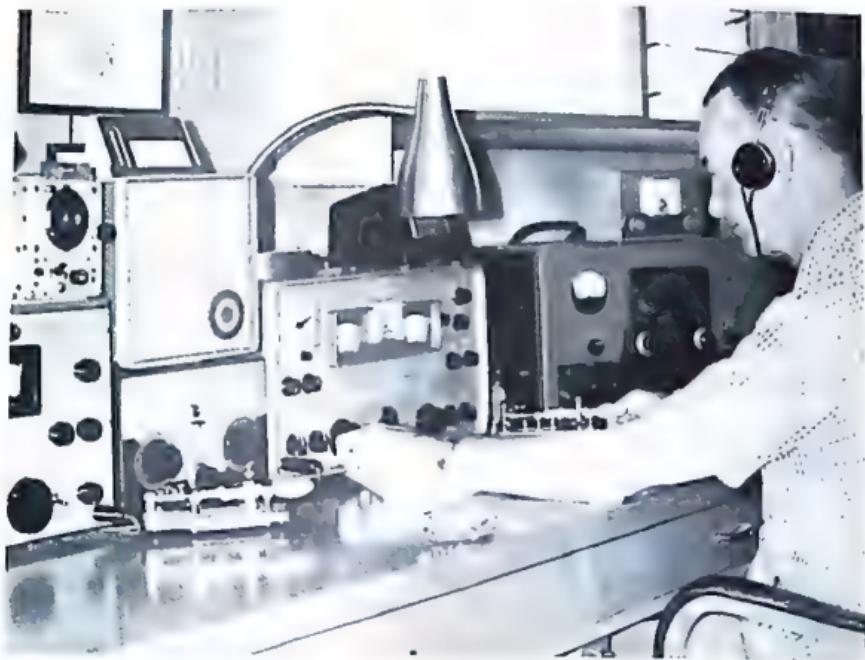
Even a basement corner makes a neat and effective ham shack when space is at a premium.





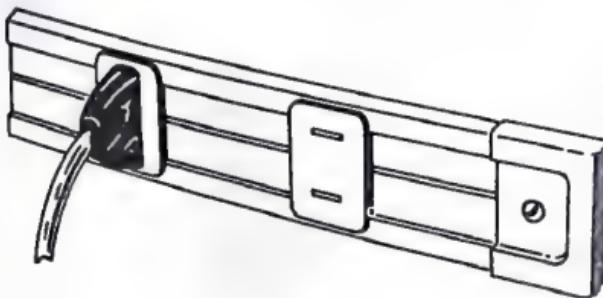
A ham shack in a garage, planned and built by Herman F. ("Hap") Helgesen, W7A1B.

Inside W7A1B. As you can see, "Hap" does not confine his efforts to only the outside of his ham shack.



desk lamp adjusted to light only your writing space and operating area. Make sure there is a wall outlet of adequate carrying capacity adjacent to where your equipment will be located. For novice operation, the 75-watt restriction on your transmitter's final amplifier input won't present much of a problem. Your wall-outlet circuits are probably wired with No. 12 wire, which has a current-carrying capacity of 25 amperes. (Open wiring. If enclosed in a conduit or cable, 5 amperes less.) The average novice transmitter and receiver, plus all accessory equipment such as a CONELRAD monitor, room lights, electric clock, etc., require far less current than does an electric heater or toaster, or even an electric iron! You are perfectly safe in supplying your gear from such a wall outlet. If you use an electric heater, it should be supplied from a different circuit, just to be extra safe.

Ordinarily a wall outlet will accommodate only two plugs. Common practice is to insert cube taps in each socket when more devices are to be accommodated. This is bad practice and leads to trailing cords and other hazards. Much better are plug-in strips, sold in most electrical and hardware stores as well as by mail-order



Plug-in outlet strip with up to six outlets, spaced about six inches apart, provides all the AC outlets you'll need, and makes an effective mounting.

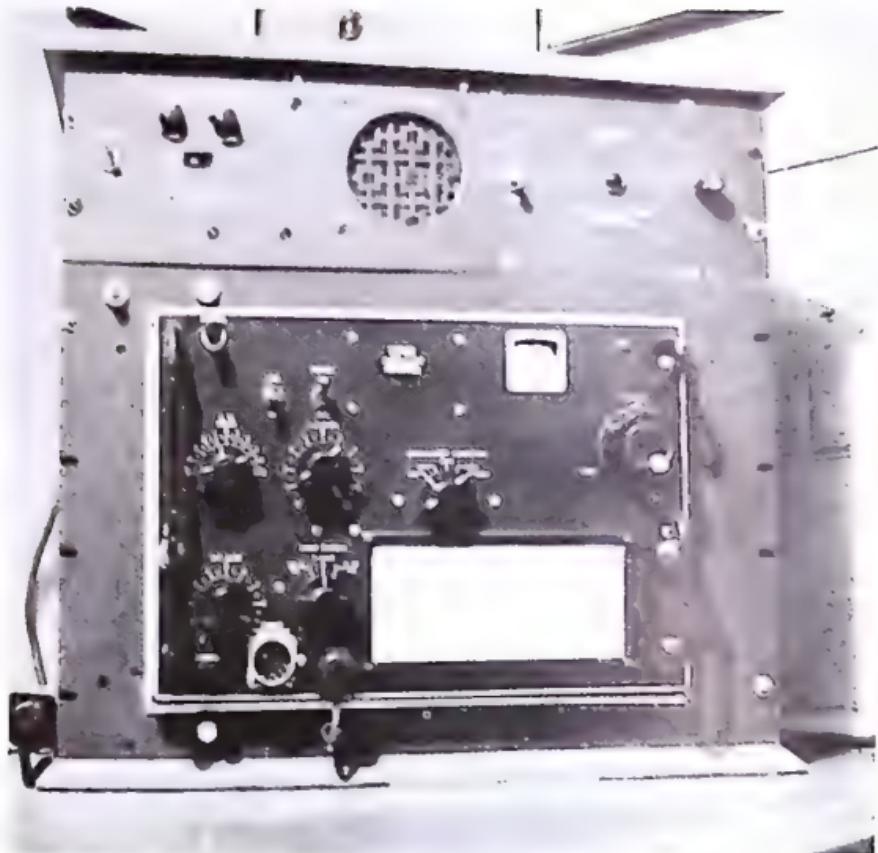
houses. These usually come in three-foot lengths, have six outlets, and are fitted with a flexible cord and plug at one end. By plugging into a conventional wall outlet, you have six outlets immediately available! That is probably more than your equipment will require for novice operation. Mount the plug-in strip neatly on the baseboard of your shack, on the back apron of your operating table, or on the wall just below the lower edge of the table. At any rate, locate it inconspicuously so the various cords from your equipment can be concealed behind the gear, rather than straggling about the table or on the wall or floor. Such an arrangement will take care

of your novice requirements for AC power, but if you are a licensed electrician, it is better to install a completely separate, fused circuit. When you reach general-class status, this will be a wise thing to do anyway, since you will undoubtedly acquire more equipment demanding more power. The plug-in strip arrangement will suffice, however, for the novice period. An additional convenience would be to connect a double-pole, single-throw toggle switch (10 amps, 125 volts) in the cord of the plug-in strip. In this way you can turn off all your equipment without having to throw a half-dozen individual switches or pulling the plug. This arrangement, as well as a few suggested operating benches and equipment layouts, are shown in the accompanying illustrations. One precaution, though. Although these plug-in strips are Underwriter's-approved, local ordinance may prohibit their use, since the electrical codes of some cities are more stringent than the Underwriter's Code. Inquire at your local building inspection department or power and light company first. If you cannot use the plug-in strip, it will be necessary to provide a separate circuit for your radio equipment.

THE OPERATING POSITION

By now you should have chosen where you are going to locate your operating bench, table, or desk. If you will be in a windowed room, try to place it near the window, to take advantage of natural light during daylight operation. Preferably the illumination should fall over your left shoulder (unless you are a "southpaw") to avoid annoying shadows. A desk or table in the center of the room is a poor location. It means wiring across the floor or rising to the ceiling, which looks messy and creates a hazard. Try to have at least one end of the table or desk against the wall. Placing the back to the wall will permit the best concealment of cords. Your operating bench should be large enough to accommodate any equipment you may later add. A bench or table top five or six feet long and about thirty inches wide is adequate. Doublechecking can be resorted to, with no loss in convenience or appearance, should your equipment overrun the available space. Sometimes an "L"-shaped arrangement can be used; in others, a "U" shape will be more adaptable. The writer, in his six-by-six foot shack, does not feel at all crowded with a "U"-shaped arrangement. This provides two table tops for main operating positions, with an upper deck on each. A single small shelf between them (the connecting link of the "U") accommodates a typewriter. There is adequate space for a swivel chair, as well as a built-in settee with a storage cupboard below!

If it is necessary for you to construct an operating bench, we most emphatically recommend that it be built-in. Of course, if you live



Mounting the receiver in a standard 19" relay rack panel with speaker, power supply, fuses, and control switches makes a compact, attractive installation.

in rented quarters, the landlord may frown on such a procedure. If you can't nail the bench to the wall, make it four-legged like a conventional table. At least that will leave the landlord's walls intact, and you won't be stuck for a bill of damages when you move! One convenience of a four-legged bench is that you can fit the legs with casters, so you can pull it away from the wall to get at the wiring in the back.

Paint your bench or table to take away the raw-wood effect. Medium dark green is claimed to be the easiest color on the eyes, particularly under artificial light. Fit your writing space with a sheet of plate glass. Not only does it provide an ideal writing surface, but you can keep many charts, schedules, and similar information underneath, where they will be readily visible. Plate glass is expensive. The writer procured a front window from a Model "A" Ford for \$1.50 at a wrecking yard. Maybe you prefer to cover your bench with linoleum or other counter topping. Make the job a good one

by installing chrome molding around the edges. Again, the cost is really small, compared with the much improved appearance. You are looking forward to many pleasant hours in your ham shack; so why not make the surroundings attractive as well?

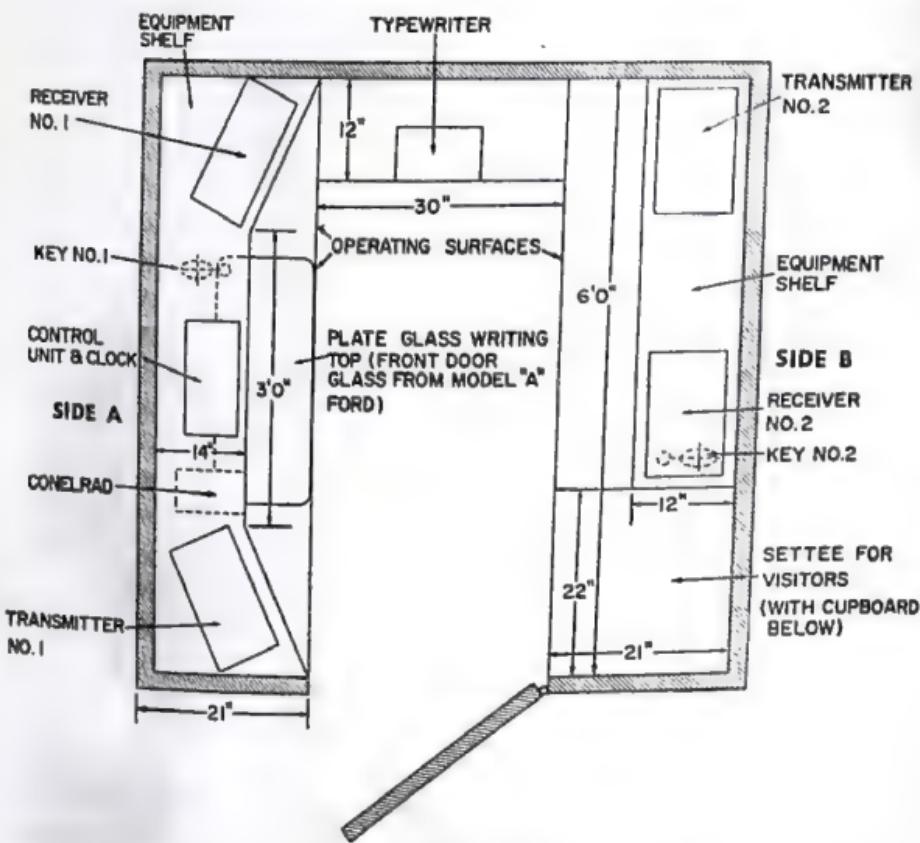
EQUIPMENT PLACEMENT

Since the receiver requires constant attention as you tune for signals and adjust the volume and other controls, it should be in a convenient position. Common practice, if you are right-handed, is to place the receiver on your left. This frees your right hand to write while adjusting the receiver controls with your left hand to follow the signal. Your right hand is also free to operate the key. (If you are left-handed, place the receiver on your *right*.) It naturally follows that the transmitter controls, particularly during your novice year, are handled far less frequently than the receiver is—certainly most infrequently during a *QSO*. The hand key is placed between the transmitter and receiver. If you are right-handed, put it to the right center. Left-handed hams will usually mount the key to the left.

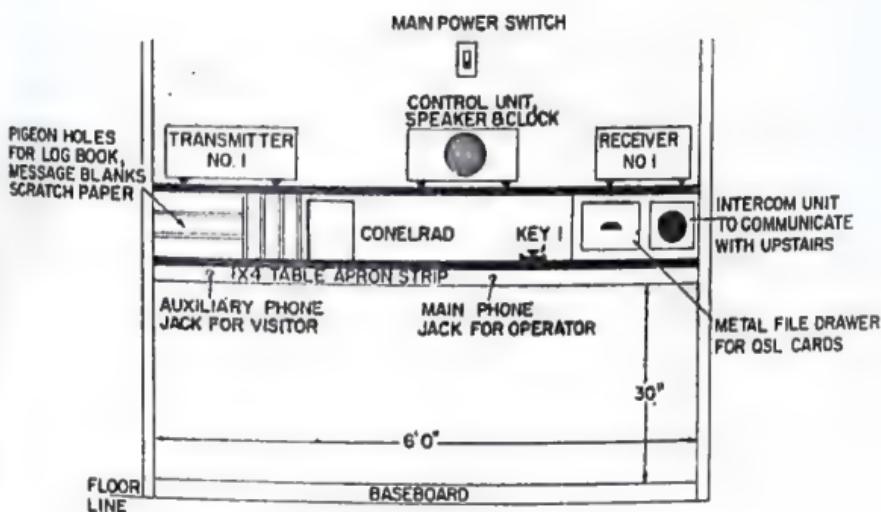
The antenna switch should be near the key, either to the right or left. Incidentally, you can pick up a nasty shock from the exposed metal parts of the hand key. The keying arrangement of some transmitters, both in factory-built and kit form, is such that a DC voltage is put on the key, and you can get a bit of sting if your fingers slip off the knob! You can avoid this by wrapping electrical tape around the key lever, from the knob back to the trunnion point, or by slipping a piece of spaghetti sleeving over it. Better yet, do like experienced hams—confine your fingers to the knob, where they should be! Follow all of these suggestions if you are particularly susceptible to electrical shock.

In addition to convenient arrangement of operating *equipment*, you are going to need space for your log book, message blanks, call book, scratch paper, pencils, and other operating supplies. This is no particular problem in most ham shacks. Books and papers can be tucked between equipment items, and pencils occupy little room. Maybe not as neat as a predetermined space for all of them, but the major thought is to have them accessible.

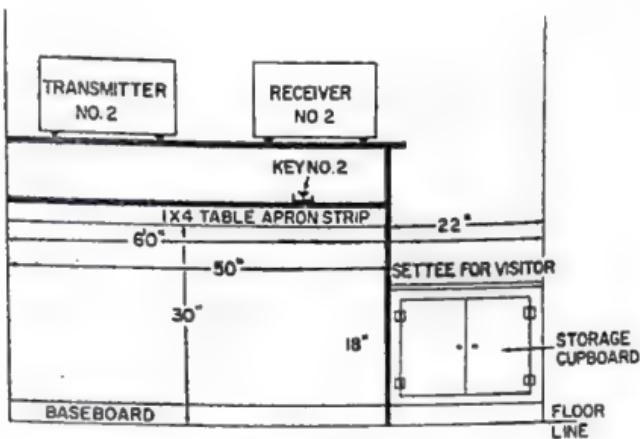
Perhaps minor from the equipment standpoint, but most certainly a major comfort item, is a chair. Maybe you've worked hard all day at your routine job. You come home from work, eat your dinner, maybe glance at the headlines, then make a beeline for your shack. Since you will spend many pleasurable hours in a sitting position, you should therefore provide yourself with a comfortable chair. The writer procured a swivel-type, armless desk chair at the



Plan view of the author's station, W70E. Although only 6' by 6', the station takes full advantage of all available space, without crowding, by the use of equipment shelves above the operating surfaces. This can be more clearly seen in the adjacent illustration, a front view of sides A and B as seen from the operating area. Two complete sets of transmitting and receiving equipment have been installed here, one (No. 1) for general hamming, and the other (No. 2) for traffic net operations. Both transmitters are all-band and have both crystal and VFO control so they can be used interchangeably in event of breakdown. A space 30" by 5' is available for a swivel desk chair.

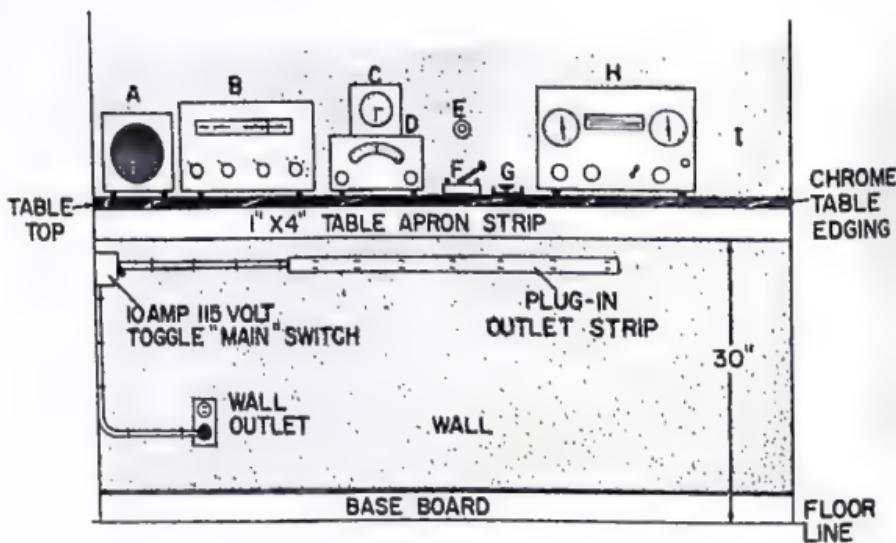


SIDE A

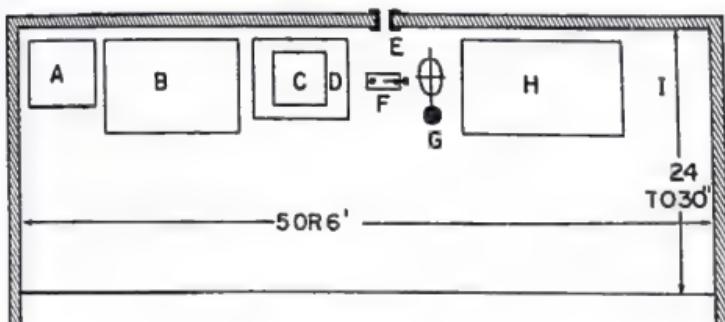


SIDE B

Elevation of both sides of author's operating shack, showing the arrangement for two sets of station equipment. Additional space is available on both equipment shelves, if and when required. The typewriter shelf is 26" high for more comfortable typing.



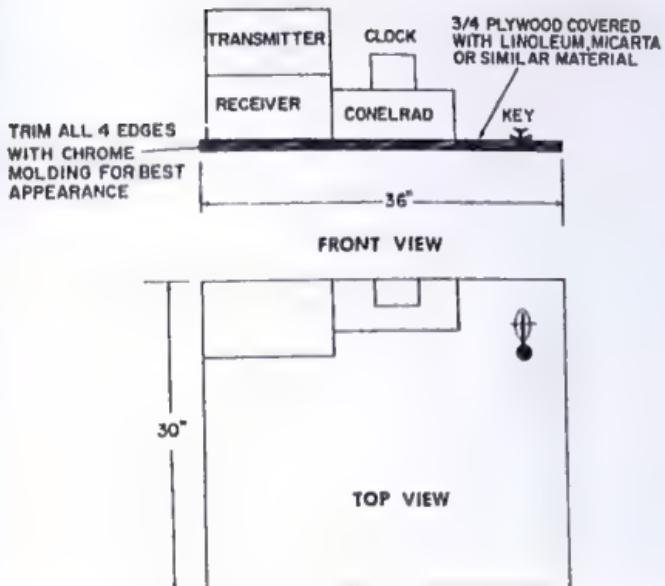
FRONT VIEW



TOP VIEW

A. Speaker	E. Antenna lead-in bushing
B. Receiver	F. Antenna change-over switch
C. Clock	G. Hand key
D. CONELRAD monitor	H. Transmitter
I. Space for log book, scratch paper, call book, pencils, etc.	

A neat, attractive, and efficient arrangement like this can be used where space is available for a built-in operating bench 6' long by 30" wide. The various items are identified alphabetically below the illustration. Notice how the plug-in strip is neatly mounted under the bench, providing convenient outlets for the various pieces of equipment.

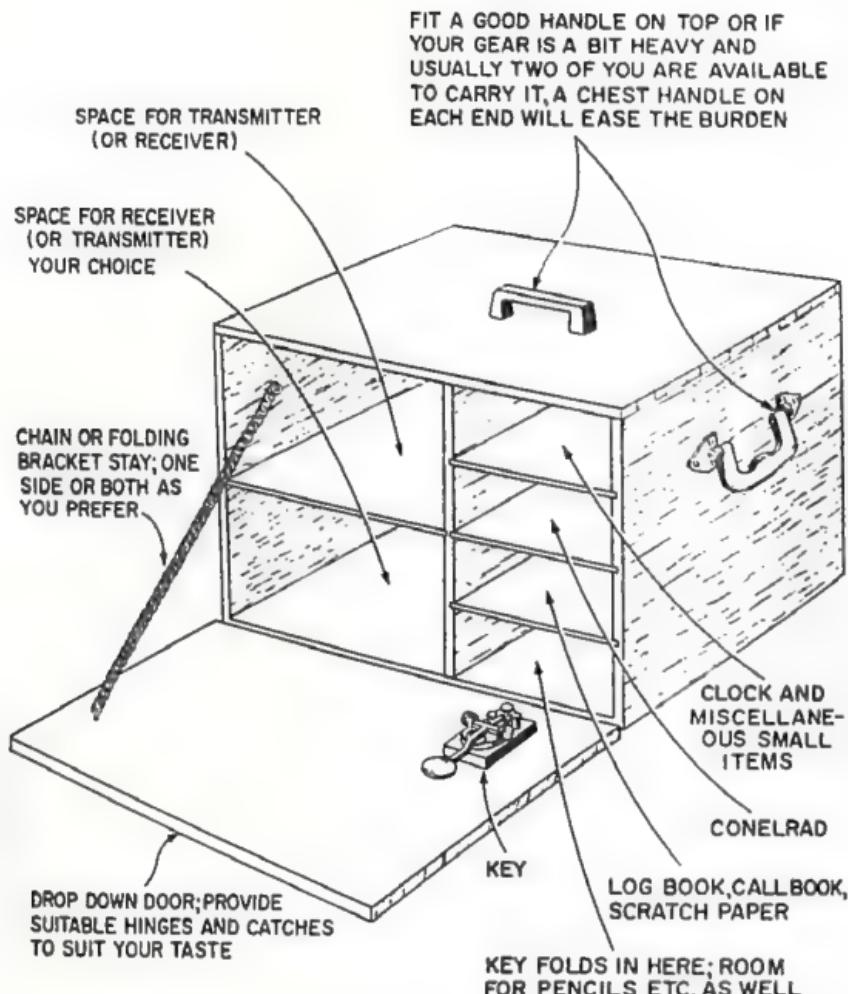


If you're really cramped for space, you can assemble a neat-appearing and reasonably convenient novice station on a breadboard. The plywood panel can be set on a night stand, and the whole station can be put away and set up again in just a few minutes.

It also has advantages as a portable rig.



Wilson Moore, owner/operator, has been on the air for more than 35 years, even though his ham shack is confined at one corner of his apartment.



If none of the previous layouts fits your needs and you're really cramped for space, how about a neat, compact arrangement similar to this one? A novice ham station in a box! Even the smallest apartment has a closet or some other space where this ham-station-in-a-box can be stored when not in use. And don't lose sight of its advantages as a portable set when you take a vacation trip or participate in field-day activities.

The dimensions you'll have to work out yourself, based on the over-all size of your equipment and the number of miscellaneous items you wish to accommodate. The average novice equipment, however, should fit in an enclosure like this one, which is no larger than 30" long, 18" high, and 12" deep. The case can be built from 1/2-inch plywood and the individual section for miscellaneous items may be placed on either the left or right side, whichever is more convenient.

local Salvation Army store for three dollars! If you have space in your shack, provide somekind of a visitor's chair also. It need not be as comfortable as yours, since the run-of-the-mill visitor only stays long enough to "ooh" and "aah," shake his head, and go away mystified. A built-in settee like the writer's is excellent. Moreover, there's quite a bit of space underneath for a cupboard to keep supplies in.

Your ham shack will need little else. You'll want to make out and answer *QSL* cards (you're a poor ham if you don't!). You'll need to keep envelopes and postage stamps convenient. If you're "in the chips," an extension phone is mighty handy. Such refinements, of course, are entirely up to you. They are offered here merely as suggestions, but they all add up to the ideal novice ham station and will carry you right on through the higher grades. Eventually you will no doubt have them all! Set your sights, save your pennies—and determine to be a *good* amateur, even in the novice grade!



CHAPTER 7

TESTING AND MEASURING EQUIPMENT

It is entirely possible to assemble and place on the air a novice ham station with not much more than a screwdriver and pair of pliers, but its legality would be pretty questionable. It's like a jalopy automobile: As long as the crankshaft turns over, the thing would run after a fashion, even though the tailpipe spewed water and about every fifth revolution of the shaft produced a "ka-pow." Chances are it wouldn't be long before the police towed it in for being a public nuisance.

The same applies to a radio transmitter. Sure, maybe a neon lamp held near the tank coil will light, or a dummy-antenna light bulb will glow. Either indication means the set is radiating, but we'll wager that in most cases the radiation is illegal! Most certainly it will be a l-o-n-g way from efficient! You've dropped more than nickels and dimes in such a combination of gear. In return for your investment, you want to get the most from it, don't you? You wouldn't put your hard-earned paycheck in a bank paying one and one-half per cent interest, if just as reliable a one across the street paid four per cent. Neither do you need to put up with poor, or at best, mediocre returns from your investment in ham radio gear, regardless of how little it might be. Let's see what we must do.

Rule of thumb is to some extent like the aviator's phrase, "flying by the seat of one's pants." Contrary to all safety rules and regulations, an experienced electrician too often uses his finger to determine if a light socket is "hot." He knows about how much of a jolt to expect, and how quickly to remove his finger! No doubt his company has provided him with a voltmeter, ammeter, and neon-bulb circuit tester, among others. But they happen to be in the truck, three floors down and a hundred yards away. So he takes the easy

way! This is a poor practice, to say the least. There are as many (if not more) test instruments and measuring devices for electronic work as there are for the electrical field. You won't by any means need *all* of them—only a few which are vital if you want to handle your ham gear intelligently and safely. Let's examine the minimum requirements for such test and measuring instruments.

SIMPLE BUZZER TESTER

One of the most convenient and simplest test devices around a ham station is a buzzer-battery combination. Although greatly limited in versatility, it nevertheless will help you in locating short or open circuits in ham equipment and also in household appliances. Briefly, it consists of a buzzer and battery. A flashlight cell or the larger No. 6 dry cell will serve adequately. If you're through with your code-practice buzzer, you can use it as a test buzzer. Wire it and a battery in series with a couple of three-foot lengths of stranded hook-up wire, and attach some sort of probe to the open end of each wire (merely tinning the ends will do, if you have nothing more suitable). Before making any tests, be sure to disconnect the equipment from the power source. Then, by touching the probes across the primary of a transformer, for example, you can tell by the buzz that the transformer winding is not open. Be sure, though, *not* to connect the test buzzer to the house wiring, or the 4th of July will come early for you!

The same procedure can be used to test anything that will normally have low-resistance continuity. If the buzzer does not sound, either the circuit or component is open, or it has a normal resistance sufficient to drop the voltage to where it will no longer activate the buzzer. A transformer secondary winding designed to produce high voltage (say, 500 volts or more) may not indicate on the buzzer. On the other hand, you may get a faint click from the buzzer armature if it is good; nothing if it is not. The lower-voltage filament windings, like the primary, will produce a good, strong indication. If touching the two terminals of a capacitor produces a buzz, you can be rather sure it is shorted. Resistors, like high-voltage transformer windings, produce a faint click, a loud buzz, or nothing. A 10-ohm resistor, if not open, will give a loud buzz; a 500-ohm resistor, may give just a click. And a 1,000-ohm unit will probably not give any indication at all. It is always wise to disconnect at least one side of the components when making these tests; the circuitry may be wired in parallel and cause a defect to be indicated, even though the equipment is in good condition! One distinct advantage of the buzzer tester is that you need not keep one eye glued to the meter; the buzzer reports to you audibly.

VOLT-OHM-MILLIAMMETER

The volt-ohm-milliammeter (VOM) is probably the most versatile piece of test equipment the novice could have, and it should be the one he purchases first. As its name indicates, it will measure (1) voltage, both AC and DC, in many ranges from zero to as high as 5,000 volts in the better ones, (2) current in milliamperes throughout the amateur range (some of the better VOM's go all the way to one ampere or more), and (3) resistance from zero to almost infinity (at least up into the *millions* of ohms). This compact instrument contains all the switches, resistors, plugs, jacks, and probes required for the various readings. Best of all, its cost is nominal, considering what all it can do. Some may even be had in kit form (but may be a little tough to assemble if your experience is a bit weak). Kits are available for less than twenty dollars. Factory-assembled, wired, and tested VOM's cost more, of course. Both kits and assembled VOM's are available on term payments. Consult the ads in current electronic periodicals, send for catalogs, see your local radio distributor, and then make your own choice. You will find a VOM to be most valuable, particularly when you have to troubleshoot your gear, be it transmitter or receiver as well as accessory equipment.

ADDITIONAL TEST EQUIPMENT

Actually, during your novice year you can make out quite well with only a VOM. The simple buzzer tester, as we pointed out, is a most convenient accessory and costs practically nothing. The VOM, of course, will do everything the buzzer will do and much more—but just the same the buzzer is still pretty handy for quick spot checks when you want to avoid craning your neck to watch a meter scale. If the buzzer shows something suspicious, use your VOM to confirm it.

There are many more pieces of equipment designed solely for making various adjustments and checks. During your novice year you will hear casual reference to signal generators, standing-wave ratio bridges, antenna matching units, frequency meters, and so on. These are almost always a subject of conversation at various ham radio stores and elsewhere. Soak it in; while you may not understand all of it initially, a certain amount will "rub off" on you, and your electronic knowledge will increase. These devices are all desirable and have a practical use, but this doesn't mean you will need all of them right now. In time, you will be able to draw your own conclusions as to what you feel you need. If your early novice experience has indicated to you that this is the hobby for you, and you're determined to progress to general-class ham, give serious thought,



Typical of VOM's which find wide usage around any ham shack is this Triplett Model 630.

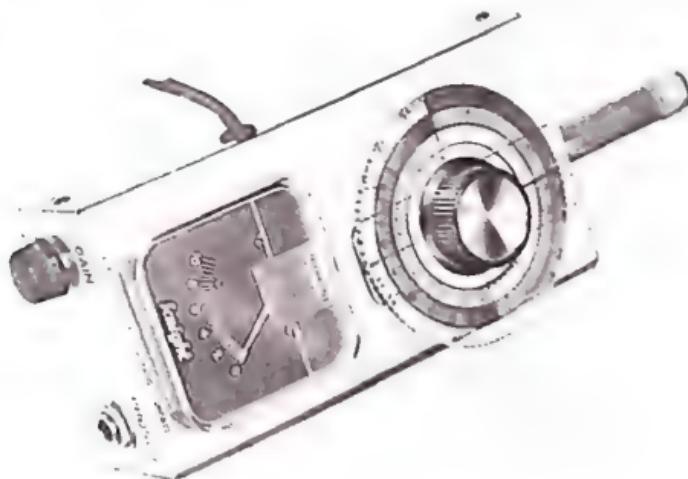


Simpson's compact and portable meter is another example of the type of VOM used by hams.

as time goes on, to acquiring as much test and measuring equipment as your requirements and budget seem to dictate.

Practically all manufactured equipment and kits include a built-in milliammeter. As previously pointed out, such a meter will enable you, through proper adjustment of your transmitter controls, to tune your transmitter to its maximum efficiency. You can take the word of the manufacturer as to the voltages appearing at various points, provided the transmitter is supplied from the specified power source. Therefore, even a volt-ohm-milliammeter is not essential for proper legal adjustment of your transmitter circuits. It is, however, very much of an asset when you are chasing "bugs" in a kit you have assembled which does not seem to perform as it should. Likewise, in a factory-built transmitter, the capacitors, resistors, and similar components are not immune to "giving up the ghost" occasionally. Here is where your VOM (as well as your buzzer tester) will prove invaluable.

Common sense is your best guide. If your transmitter suddenly ceases to operate, it is obvious that something is wrong. Think it out, and then use your buzzer and VOM to confirm your suspicions. A new transmitter should perform satisfactorily the first time it is placed in service. If not, do not follow the rule-of-thumb method of attempting to tune for minimum smoke! Instead, shut off the transmitter and start delving for the trouble. Without a VOM, or at least a volt-ohmmeter (which does not carry a milliampere scale),



A grid-dip meter permits resonance readings in all ham bands, serves as an absorption wavemeter and field-strength meter.

to measure circuit continuity, or to check for open or short circuits and to measure voltages and resistances, you are sunk.

So the minimum test instrument required is either a volt-ohm-milliammeter or a volt-ohmmeter (the latter is somewhat cheaper), plus the milliammeter on your transmitter. You will no doubt make up a buzzer tester, too, since it is such a simple, practically no-cost item. What to add next and in what sequence, you will discover through your association with other hams. Balance this with what the various manuals and handbooks tell you, and it won't be long before you accumulate a modest setup of test and measuring equipment which, intelligently used, will really paint you a picture of ham-radio equipment performance. A grid-dip meter, for example, is a mighty handy contrivance, and a reflected-power or standing-wave meter will also prove invaluable in time. An antenna tuner may be the next item you will want to buy. Absorb information from all the published data you can lay your hands on, together with what you pick up from other hams, both on the air and face to face. It will pay off!

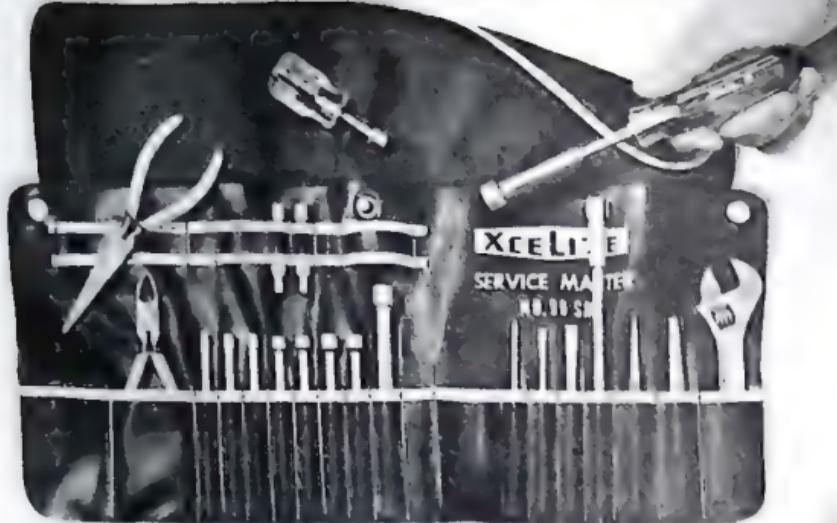
CHAPTER 8

THE NOVICE HAM WORKSHOP

Regardless of whether you buy a factory-assembled novice station or one in kit form, you are going to need a few simple tools and a place to use them. Somewhat more tools will be necessary if you are one who likes to build from the ground up. And as you advance in your new hobby of ham radio, additional tools and supplies will gradually be accumulated. So you may as well plan now for the future. A workshop corner of some sort is generally available in a basement, attic, garage, or other outbuilding. A bench and a few hand tools such as a saw, hammer, pliers, and screwdrivers comprise the minimum.

Suppose we discuss the single-dwelling home accommodations for such a shop before considering the necessarily more limited space problem of the apartment dweller. Regardless of whether it is a basement, attic, garage, or other outbuilding, the minimum space requirements will be about the same. It should be pretty obvious to you by now that there is more work involved than merely unpacking the transmitter, plugging it into a wall outlet, and attaching a key. Sure, the key may have come in the same package, but how about the key-to-transmitter cord and plug? And where is the antenna you will require in order to radiate a signal? Are sufficient outlets available to accommodate your transmitter, receiver, CONELRAD monitor, and maybe an electric clock and a desk lamp? Probably *not!*

You have two outs—if you happen to be “Mr. Gotrox,” you can call in an electrician, carpenter, linoleum layer, etc., and tell them what you want, aided perhaps by the advice of a more experienced ham friend. Or like the vast majority of hams, you can do it your-



By adding a small soldering iron and a $\frac{1}{4}$ " drill to the Xcelite No. 99 SM Service Master Kit, you'll have all the tools you'll need for your workshop.



Round and square chassis punches let you cut clean, smooth holes in metal up to 16 gauge.



"Nibbling tool" costs less than \$4.00, will go through steel up to 18 gauge, or $1/16$ " aluminum, copper, or plastic.

self. Frankly, the writer feels that much of the satisfaction in joining the ham fraternity comes from using your own ingenuity in planning your layout, and in performing the physical labor of creating it! The latter simply means that after thoughtful consideration, you approach your local lumber yard, pick up the necessary lumber, nails, putty, and what have you, and sweat it out. What's more, after you have completed your shack and are ready to install the equipment, you will still have a number of physical operations to perform. It will be infinitely easier if you first provide yourself with a place to work. A small workbench and sufficient tools will make the job not only easier, but more pleasant as well. Ten to one you already have a bench in a corner of your garage or basement, and you've probably accumulated a hammer, saw, pliers, and screwdrivers. This should see you through the construction of an operating bench, partitioning of your radio shack, and similar carpentry. You'll find some hints for operating space in an earlier chapter. Right now let's assume you have sufficient tools and working space to take care of the initial phase.

How about electrical and electronic tools? Not that you must supply yourself with a fancy collection of gadgets. Certainly a pair of automatic wire strippers is an advantage—but a jackknife or a pair of diagonal cutting pliers will do a good enough job of wire skinning. Likewise, if you want to start from scratch with a raw chassis and drill and cut your own holes, you'll find many tools available to make your work easier, such as chassis punches for large holes, an electric drill, and reamers to enlarge undersized holes. Actually, you don't really need them! You can cut a large hole by laboriously drilling a circle of small holes with a hand drill, cutting between them with a hacksaw or chisel, and patiently filing the opening reasonably round. This is doing it the hard way, but if that's the way you like to do it, there is nothing to hold you back!

Our recommendation to the home owner equipped with only a workbench and a few hand tools is not to attempt to build a piece of equipment from the raw materials without previous experience in electronic construction. Take the easier way—stick to the kit type of construction for your initial efforts. It requires infinitely fewer tools, and certainly much less physical exertion. The time element is substantially reduced as well. In addition, by following the step-by-step procedure in the kit manufacturer's instruction manual, you will learn more about electronic components and about accepted assembly and wiring practice. After you have served your novice apprenticeship, you will feel more confident to tackle from scratch the electronic projects appearing in periodicals and handbooks. The minimum tools you need to do an acceptable job of kit assembly

and wiring include a four-inch and a pocket screwdriver, a pair of long-nose and a pair of diagonal cutting pliers, a six-inch adjustable jaw wrench, and a 50- to 75-watt soldering iron. These will form the nucleus; the others you can add later as your interest grows.

Your shop and bench space requirements won't be large. If you already have a bench about four feet long and twenty-four to thirty inches deep, that's all you need. Excellent kit assembly and wiring have been accomplished on the kitchen table, after the dinner dishes have been washed. It's a little rougher there, because the "little woman" will no doubt insist that you clean up after every construction session, rather than leave the parts until the next session. All materials and supplies are included with the kit. All holes are drilled and punched, the wires are already cut to the proper length and skinned, and even a generous amount of wire solder has been included. What more could anyone want?

After you have determined to continue with ham radio as a hobby and have qualified for your higher-grade license, think about expanding your shop and equipment. Shop and bench space are not too important, so they can remain at the initial minimum mentioned in the preceding paragraph without cramping you too much. After all, electronic equipment is not really large—you are not building a boat or overhauling an auto! You will need to give thought to storage space for parts and such, however. You'll be surprised at how they just seem to pile up on you. In a surplus radio store you see a musty audio-amplifier chassis simply oozing with capacitors, resistors, transformers, sockets, and what not. And the dealer only wants a dollar for it! How can you pass it up? It may be no good for its original purpose, but what a treasure of small parts it can supply. Hams are like pack rats; they simply drool when something like this turns up, and their sales resistance drops to zero (you should see the writer's basement!). An accompanying photograph illustrates the arrangement the writer now uses. It is merely a thick partition (about six inches between walls) fitted with cupboard doors, with suitable shelving to accommodate some sixty coffee cans. All the cans were enameled black in one evening. The next evening, the white lettering was painted on each can. This is about the handiest arrangement you can imagine. Everything is labeled and everything is handy. Nevertheless, practically all the cans are overflowing and additional space is needed. Fortunately your problem, as a novice, will not be this severe. Much of the writer's materials date back many years, because he (like all hams) is most reluctant to part with anything he thinks he may have a use "some day"! At any rate, provide as much shelf and cupboard space as you can. Meanwhile, keep an eye out for expansion.



Sixty 2-lb. coffee cans or 120 1-lb. cans fit in a cupboard-partition 48" X 42" X 6", hold all the spare parts you need, let you find what you want instantly.

If you have room, it's best to mount your tools on a board. That way, everything's at your fingertips.



You may already have a few electrical convenience outlets at your workbench, but you'll probably need more. It's a good idea to provide one or even two plug-in strips just below the top of your bench, on the front apron, as suggested previously. Spacing them along the front apron makes them really convenience outlets—you always have one within reach, to plug in a power tool or piece of gear. For storing tools, your best bet is a tool board mounted on the wall, directly above the bench. Merely tossing your tools into a drawer or tool box means digging every time you look for one. But if they are hung in orderly fashion on a piece of wall-mounted plywood or *Masonite*, all you need to do is reach—not "paw"—for the one you want.

Since you are going to spend many pleasant hours in your workshop, make sure it's convenient, comfortable, and attractive. Light it well, and for the sake of appearance don't spare the paint, varnish, and shellac. Cover the top of your bench with *Masonite* or a similar hardboard, and give it a coat of shellac or varnish. Here's a tip: if you clean your shop after each operation or at the end of the day, it will take you only ten or fifteen minutes. But make it a weekly chore, and it may take you hours!

Now let's take a look at the apartment dweller with no space for the ham shack, and certainly none for a workshop. Yet he needs both to really enjoy his hobby. In Chapter 4 we offered some solutions for the antenna problem. You'll find suggestions for compact ham shacks in Chapter 6. We'll see what we can do about workshop space. First, let's examine the "miniaturized" workshop.

The most satisfactory solution to limited space is to follow the practice of many automotive service shops. They find it easier to take the tools to the engine, rather than bring the engine to the tools! We'll adopt the same philosophy. If you will look in a mail-order catalog under "Cabinets—Tools," you'll find numerous steel cabinets with flat tops, and drawers which will accommodate an unbelievable number of tools. These cabinets are usually mounted on casters. They are roughly three feet high, two feet wide, and eighteen inches deep, and cost around thirty-five dollars. You would have to spend that much for lumber, nails, labor, etc., to build a shop; besides, this one is already built for you. And even if you can save a few dollars by building such a cabinet yourself, is it really worth the time and effort, when this one is ready to go the minute it is delivered to your door?

"So," you say, "where do I put it?" Living in an apartment as you do, there just isn't any room. But you do have a closet or two, or a similar cubbyhole. Maybe it is cluttered with your pajamas and tuxedo. Tuck the pajamas under your pillow, and toss the tux under

the bed! Stick all of your accumulated tools, parts, and supplies in the various cabinet drawers, and wheel the thing into the closet, out of sight. Then just roll it out when you need a workshop. You can do the same with your receiver and transmitter if you're cramped for space. You can even set them on top of the portable workshop cabinet, and lift them off when you need shop bench space. So, now that you have a place for your tools, and a small bench top to work on, what's to stop you from enjoying ham radio—first as a novice, and later as a general? The writer knows one couple with several children, living in somewhat confined quarters, who go even further. Their ham rig is built into the lower portion of a bookcase in the living room, and they do most of their operating by lying on their stomachs in order to reach the controls! Who says hams aren't adaptable?

CHAPTER 9

STATION SUPPLIES, CLUBS, AND OTHER ORGANIZATIONS

No ham station can go on the air without certain miscellaneous supplies, for greater operating convenience as well as for legal compliance. Foremost among these is the legal requirement that each station maintain a complete record of its operations. This merely means the date, time, frequency, etc., covering each period of transmitter operation must be kept. Whether such information is entered on homemade sheets or on one of the several standard forms available makes no difference, as long as the essential information is all there.

STATION LOGS

Because standard log books—consisting of blank printed forms containing columns and space for all entries—are available at low cost, it is hardly worthwhile to make up your own sheets. For example, the American Radio Relay League, Inc., publishes log books in two sizes: 8½" × 11", customarily used by fixed ham stations; and a pocket size, 4" × 6¼", for mobile operation. Both can be used interchangeably, however. The larger size sells for fifty cents and the pocket log sells for thirty cents. Both are spiral-bound and contain space for all necessary entries for many months of average operation. They are obtainable at most stores catering to hams. We recommend one of these, or something similar. Others are also available and like the ARRL logs, contain information on how to use the various columns in the book. All log books must be kept for one year after the date of the last entry. They may then be destroyed. However, many hams like to keep their logs as a record of their ham operations throughout the years; there is no objection to this.

This log sheet from the ARRL log book complies with legal requirements, and has additional columns for valuable supplementary information.



Standard radiogram message blank, available from the ARRL at nominal cost. Although not a legal requirement, they are convenient for jotting down and preserving messages for one year as required by law.

REFERENCE	NAME OF STATION	TYPE	PLACE OF ORIGIN	TIME RECEIVED		DATE
				FROM	TO	
T	AMATEUR STATION PHONIS	AMATEUR STATION	THIS RADIO MESSAGE WAS RECEIVED AT			
	OWNER	STREET ADDRESS				
	CITY AND STATE					
SIGNED, ALONG WITH PHONE NUMBER OF RELEASER						TIME
FROM STATION						OPERATOR
RECD						

MESSAGE BLANKS

Although not a legal requirement that you use *printed* message blanks, anymore than you need *printed* log books, you must keep a copy of each message for one full year, after which it can be destroyed. Unlike the log book, there is no point in preserving messages beyond the legal year, and they are customarily burned at the end of that period.

Certain information must be contained on whatever form is used for formal messages, whether you originate the message yourself or accept it for transmission to another person. The latter messages, termed "third-party traffic," can be sent for others to almost every country in the world. *QST* magazine and various other publications publish current information on this, and they should be consulted when you are in doubt. Regardless of where a message is going or where it originated, it should contain a serial number, the call letters of the originating station, the city or town of origin, and the time and date of filing. This information is known as the "heading" or "preamble," and the conscientious amateur will refuse a message which does not carry it. Other considerations include proper address, text make-up, and signature. The time of transmission or reception, as well as the date such transmission or reception was accomplished, must also appear on the face of the message. More detailed information on message handling is available in current local publications, as well as in *Operating an Amateur Radio Station*, a twenty-five cent publication of the ARRL, and in various manuals devoted to message handling.

As with log books, you can save yourself much laborious scribbling by purchasing printed message blanks. They closely resemble a Western Union message blank, but are slanted to ham radio. Use of such forms, particularly where the message is for a third party, greatly enhances your prestige, as well as giving the recipient a greater respect for ham radio. These message forms can be bought from the ARRL, in pads of 70 forms, for thirty-five cents each. They are also available as postcards (unstamped, of course). By all means, stock your station with one or more pads of these forms, as well as with an adequate supply of cards, if you expect to do some third-party message handling.

QSL CARDS

By now you are no doubt familiar with the international practice of acknowledging your first communication with another station through the medium of a postcard, known as a *QSL* card. The abbreviation *QSL* on the international "Q" signal abbreviation chart

3434 74th Avenue S.E., Mercer Island, Wash. (Near Seattle)

TO RADIO

Confirming QSO

at _____ PST

On _____ 19

Year _____ MC CW

FOINS Signals were

R ... S ... T ...

THX QSL PLS

"73"

MEMBER

Veteran Wireless
Operator's Assn.

DeForest Pioneers

OM, OM T-ers
Club

Quarter Century
Wireless Assn.

W7OE

HOWARD S. PYLE, "YB" Owner-Operator

On the Air since 1908—

Formerly MA and HP (before 1912 Recording Ind.)

Also on 7N8, 7F2, 7NG, 7OE, 8E1, 8FT, 8DA1, 7AH, W7ASL

(Subsequent to Radio Act of 1912)

RIG HERE
Viking Ranger
Transmitter

HALLICRAFTERS
SX 99 Receiver

COMPOSITE
Control Unit

ORS
OTC
A-1 OPR
CPC
NTS

Some popular styles of QSL cards. As you can see, they are limited in design only by your imagination.



To _____

LHASA
TIBET

AC4RF

QTH, % GYANTSE P.O.
VIA SILIGURI, W. BENGAL, INDIA.

Confirming QSO on _____ at _____ on _____ Mc/s.
Your Signals _____ CW/F

Pse QSL via R.S.G.B. 73. R.W. FORD.

means, "Please acknowledge" or "I acknowledge." *QSL* cards, a practice started many years ago, have become a must in ham radio. As one ham once told the writer: "A ham who doesn't "QSL" is not a *ham*; he's an *egg*!" So you're just about obligated, although not legally bound to do so, to join the bunch and provide yourself with *QSL* cards.

What you use for *QSL* cards is of little concern, as long as they contain the essential information the other ham wants to know. The date and time of contact and the character of his signals (strength, readability, and if CW, the tone or note) are important to him, just as they are to you. You too, want a confirmation of what your signals sounded like at his shack. In designing such a card yourself, you have all the leeway in the world. You can let your ingenuity run rampant. They can be made by hand, in pencil, ink, or crayon, if you want to go to all that trouble for each individual contact, or on a duplicating machine in one or several colors. You can even make up a design and submit it to a job printer for a quotation. However, it may seem high, particularly if you want more than one color. If you do have them printed, it will pay you to order at least 500, because the cost per card drops (up to a point) as the quantity increases.

You are not limited to custom-designed printed cards. Many printers, a majority of them hams themselves, offer a wide variety of standard designs, at much more nominal prices than individually printed cards. They can do this because they print thousands of cards at a time. The cards lack a name, address, and call letters, which are added when you order. Only a minor typesetting job is involved in inserting this data, and the cards can be printed in a contrasting color at no additional charge. Consult the advertising columns of the various ham periodicals. You will no doubt find a printer near you who will submit a number of sample cards to choose from. Even imprinted with your name, address, and call letters, in lots as small as 100, these cards will cost you substantially less than individually designed ones. Some hams even make up linoleum blocks and print their own cards (in one color ordinarily) by using a rubber-stamp pad.

RADIO CALL BOOK

An amateur call book, as you probably know, is an alphabetical listing of amateur radio stations by call letters, together with the name of the owner/operator and his or her mailing address. Such listings were once available (1915-1916 era) from the Government Printing Office in Washington, D.C., (only U.S. amateurs, however) for fifteen cents a copy! Alas, not anymore! In those days, amateur

stations were few, the book was thin, and the cost of publication small. Today? Well, with something over 200,000 amateurs in the United States alone, such a call book would approach the size of a telephone directory in a city of comparable population. Add to that the amateur stations throughout the rest of the world, and you can appreciate what a monumental listing it would have to be.

A long time ago the government found it necessary to literally throw up its hands, not only for the responsibility of publishing such an amateur call book, but also of listing commercial, military, and naval stations in book form. The latter obligation was assumed by a bureau set up by international agreement in Berne, Switzerland. Embracing all commercial, naval and military stations of the world, the publication is issued in three volumes and in three languages. If published in one volume, it would be as unwieldy as a mail-order catalog. And the amateur? In the fall of 1920, Charles O. Stimpson a former naval radio officer, began publishing the *Radio Amateur Call Book* as a private enterprise. Starting as a modest loose-leaf publication selling at one dollar per copy, with quarterly supplements, it expanded—thanks to the tremendous growth of amateur radio as a hobby—to two editions, one listing all foreign ones. Both are of impressive size, as can well be imagined. The price has necessarily been increased and at current writing is five dollars per copy for the American and three dollars for the foreign section. Both are available at somewhat reduced cost on annual subscription. The American section is revised quarterly, and the foreign section semiannually.

Why a call book? Suppose you work a brother ham 1,000 miles away. Signals are poor, and even though you manage to make out his call letters, you miss his name and location. How do you find out where he is and who he is. If he has had his license for approximately six months, he will be listed alphabetically by his call letters, just as you will, too, after you've been licensed six months. There is no charge for such a listing. Nor do you have to request it or furnish any information—the process is entirely automatic.

You don't need to purchase a new edition every three months—or at all, for that matter. But without one, you'll suffer the same handicap you would face without a telephone directory. Many content themselves with one book a year, generally the Fall-Winter issue, since most ham activity is conducted during those months. Others manage a book twice a year, and some can afford a copy each quarter, or an annual subscription. Often the latter pass their outdated issues on to some less affluent ham. The book is available at any ham radio store. It is known throughout the world simply as the "call book," and is the only publication of its kind.

MISCELLANEOUS STATION SUPPLIES

Your miscellaneous supplies are almost obvious. You most certainly will need plenty of scratch paper on which to copy what you hear. An adequate supply of sharp pencils (a pencil in ham circles is called a "stick") goes hand-in-hand. Of course, you'll need a pencil sharpener. When you progress to the point where you can make perfect copy with a "stick" at a reasonable speed, begin to think about a typewriter (known as a "mill"). There are advantages in mastering the technique of copying on a "mill." Your copy will be clean and readily decipherable, not a pencil scrawl. Also, it takes a lot less effort, and it is much faster, to punch a typewriter key than to make the curlicues involved in transcribing by hand. It is asking a great deal to expect a novice ham to do all of his copying on a mill. In fact, it is better that you don't during actual communication with another station. If you're fortunate enough to have a typewriter in your shack, however, practice with it by copying the transmissions of the various code-practice stations (W1AW, K6USN, and others) as often as you can. In time you'll learn to ignore the sound of the keys against the platen and hear just the code in your headphones.

CLUBS AND OTHER ORGANIZATIONS

You have no doubt noticed throughout these pages the frequent references to the American Radio Relay League, Inc., more commonly referred to as ARRL in ham circles. This international organization of radio hams, which is *not* a commercial organization for profit, was organized in 1914 by the late Hiram Percy Maxim, inventor of the Maxim silencer and himself a most enthusiastic radio ham, and Clarence D. Tuska, a young college student. Their purpose was to form a chain of amateur stations through which to relay messages from coast to coast and to other parts of the country. (The range of amateur-radio stations was much limited then, and it was necessary to relay messages in order to reach moderately distant points.) Shortly after this modest beginning, they pooled their resources and published the first issue of *QST* magazine in December, 1915. Except for a short suspension during the first World War, *QST* has remained continuously in publication. It is the only amateur-radio publication which has survived, many others having ascended to their peak and then quietly faded. It is the official organ of the American Radio Relay League, and the leading publication in the world devoted to amateur radio.

Through legal representation in Washington, backed by its very efficient headquarters staff in Hartford, Connecticut, and a competent and efficient board of directors elected every two years by

the membership, the ARRL has been largely responsible for what the ham enjoys today—not only in privileges, but in his very existence as well. It has often been said, and rightly so, that without the ARRL there would be no ham radio. This should convince you that



The official ARRL emblem, available as decals for car windows and bumpers, or as etchings for stationery, cards, etc.

one of your first steps is to become a member and help swell the ranks now numbering almost 100,000 hams throughout the world. The nominal membership fee of five dollars per year includes a subscription to *QST*, its monthly publication.

At the very outset of your novice career, you should also join your local ham radio club, if you are fortunate enough to live near one. You will gain much more from your nominal investment in their annual dues (usually only a few dollars) than in any other way. You'll meet fellow hams, both novice and general, and engage in "ragchews" and "hamfests," as the social gatherings are called. Your knowledge of ham radio will skyrocket, merely by being exposed to the comradeship of your fellow hams. There are countless other organizations, both local, regional, and national, to which you may belong. If you can, join them. The more organizational activity you engage in, the more rapid will be your progress up the ladder of hamdom. Your first obligation should be to the ARRL and your local club. Beyond that, the choice is yours.



CHAPTER 10

PREPARING FOR ADVANCEMENT

By now you should have either passed your novice examination, or be about ready to attempt it. From the foregoing pages, you have also gained a rather comprehensive idea of what is required in the way of equipment, to place a novice ham station on the air. The mere fact that you have been issued a novice class license, meaning you are now able to legally communicate with others of like stature, should most certainly not bring an end to your efforts. The law says you can be a novice for one year only. After that you must either qualify for a general- or technician-class license, or else go off the air until you can. You can *never* be a novice again. Nor can you renew your novice license after it has expired.

TECHNICIAN CLASS

The novice class, as we have repeatedly pointed out, constitutes your apprenticeship. Within that year, which is normally more than ample time, the FCC expects you to make up your mind whether you want to continue as a ham by qualifying for a higher grade license, or to drop it entirely. We are going to assume that ham radio has demonstrated such a fascination that you, like most novices, will want to continue being a ham as long as you live. To do so, you are going to have to study not only theoretical principles, but the radiotelegraph code as well—unless you aspire to the technician-class license, in which case it is not necessary to improve your novice code ability beyond five words per minute. Also, you do not appear at an FCC examining point—the examination is given entirely by mail, the same as for the novice class. Nevertheless, you had better keep in practice because you will be examined again to determine whether you have retained your initial ability to send

code at five words per minute. If you spend your novice year entirely on phone, in the 145-147 mc band allotted you, it is easy for your code speed to drop off. So try to improve your code ability, even though you expect to take the technician—rather than general-class examination.

The theoretical examination for the technician-class license is another story. You will need to know every bit as much to qualify for it as for general. Not to scare you, but neither test is easy. The year you have in which to prepare after receiving your novice license is ordinarily more than ample. A really serious-minded novice can make it in six to nine months, provided he devotes a reasonable amount of time to study. The writer has known many who have qualified for technician or general class in six to eight weeks. Conversely, many have expended their entire novice year, appeared for the technician or general examination, and failed several times before making it or becoming discouraged and giving up. You can take the examination as many times as you like, at thirty-day intervals, until you pass it—but remember that you can never again be a novice, once your license has expired!

Frankly, to prepare for and eventually pass the technician-license requirements is falling a bit short of your goal. As a technician you do not become a *bona fide* ham; you are really licensed as an experimenter and are more restricted in your communication. For instance, you are limited to 220 mc and above. These are the ultrahigh frequency bands, where communication is still very erratic and, except under unusual circumstances, pretty much confined to your own area. True, "moon bounce" is producing some unbelievable results, but don't count on it as a newcomer. Of course, if your bent is purely on the scientific and research side—that is, you aspire only to experiment, with the thought of aiding in further development of these almost micrometric frequencies—technician is probably the correct license for you. On the other hand, if you are interested in exchanging chitchat with your fellow ham in Tasmania, Africa, Timbuktu, or what have you, as well as locally, get your code speed up to 13 words per minute and enjoy *all* the privileges the government makes available to you as a general-class amateur.

Obtaining the technician license is one "out" for you if you want to be a general class, but cannot quite make the grade on code. If you know the theory sufficiently well to pass the technician examination (which has the same code speed requirement as the novice exam—five words per minute), you can hold your novice call letters (dropping the *N* of course) and receive a five-year license renewable every five years without further examination. This, though, should be considered as only a stopgap, merely to hold

your call letters until you can qualify for the general-class ticket. Those who are forced to take this step usually do so through circumstances beyond their control, such as extensive travel in connection with their employment, heavy study schedules, or similar reasons. Remember, though, that you are imposing an additional hardship on the FCC, which must first process your application for technician license and then repeat the task to make you a general-class amateur a few months later. Our recommendation is to study a little harder and qualify for the general-class license right away. You do not even have to wait the full year of your novice term. Any time you feel qualified, you can take the examination for the higher grade. If you possibly can, however, try to get your code speed up to 13 wpm and take the general examination; skip the technician class completely and enjoy *all* the amateur privileges.

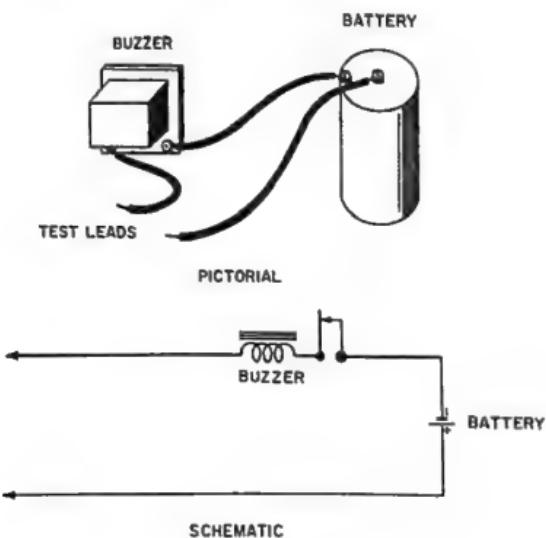
Once you've attained general status, your studying is over unless you aspire to the extra-class license—the highest grade issued to amateurs. A full explanation is beyond the scope of this book, but you can find more information in the various ARRL publications and others. Briefly, you must have held a general-class license for a minimum of two years, demonstrate an ability to both send and receive at least 20 words a minute in code, and take a much more comprehensive written examination. Unfortunately, your privileges are no greater than for the general class. It is hoped, in the not-too-distant future, the FCC will see fit to grant more recognition. At present, it is merely a matter of prestige to be an extra-class amateur, much like an honorary degree is to a professional person.

Look at the novice license as the equivalent (in its own way) of a high-school diploma. The technician class we can look at in the same light as a bachelor's degree from college. Continuing our analogy, the general class can be considered a master's degree, and the extra, a doctorate. Maybe we could convince the FCC to so grade these tickets!

GENERAL CLASS

As explained previously, there is no distinction between the requirements for the technician- and general-class license other than the code-speed requirements. Let's concentrate on what it takes from the theoretical standpoint to qualify for the general (as well as technician) class. "Theoretical" is somewhat of a misnomer, for a large part of the examination is based more on the practical than the theoretical. The questions are on practical applications of radio circuitry. Moreover, they are much more comprehensive than those you slid through so easily on your novice examination—and rightly so. After all, you're about to don your first pair of long trousers!

Probably your first concern will be to learn how to identify the symbols of the various electronic components, as used on the wiring drawing commonly known as a schematic. Instead of a readily recognizable "picture" of each component, a symbol adopted throughout the electronic industry is substituted. A schematic diagram immediately tells the skilled electronics worker which parts are what, and what wiring connects them. It does not ordinarily specify the wire sizes; nor does it show the actual routing of the wires. Pictorial diagrams, which almost invariably support the schematic diagrams in popular kit-assembly instruction manuals, are just that. They are



Schematics are part of the FCC license examination.

really emphasized line drawings, resembling in some degree an actual photograph and showing the placement of parts and the routing of the wiring and its connection points. Actually, the more experienced prefer the schematic diagram because, once learned, it is more easily deciphered and tells the circuitry story more clearly. You, too, will find this true after you have mastered the symbols. You should learn the symbols for the more common electronic components first. Study them carefully because you will be given a number of *schematic* diagrams to interpret and draw in your general and technician examinations.

You are certain to be asked questions concerning the operation of various devices used in ham radio equipment. Since, the function of this book is not to attempt to fully prepare you for the general or technician examination, we refer you to ARRL publications and

others for more detailed information. We are merely attempting to indoctrinate you in the necessity for concentrated study if you have set your sights on going beyond the novice grade. Like anything else, you cannot learn *too* much about ham radio (or anything else, for that matter). Just master it as best you can, and try to be a *good* amateur. (A good amateur abides by The Amateur's Code, which appears in Appendix B and has appeared in the *ARRL Handbook* for many, many years.)

CONDITIONAL CLASS

One type of license not touched on so far is the conditional class. Although in the minority, there are quite a number in existence and currently being issued. The examination is the same as for the general class, except it is administered by mail like the novice and technician classes. And like these two classes, a code examiner and a witness must be present to give and to witness the test. This license was established to avoid imposing a hardship on those whose homes are remote from an FCC district office or a quarterly field examination point. Should you live more than 75 miles from such FCC examination points, you are not required to appear in person before an official FCC examiner. You can instead be examined in your own area, by a general- or higher-class amateur, or by someone who is a commercial or military radio operator or has been actively engaged as one within the past five years. The same applies to persons having a physical disability which prohibits them from traveling to an examination point, if substantiated by a physician's certificate to that effect, and to military and naval personnel whose inability to appear is certified to by their commanding officer.

This does *not*, however, constitute an easy out for you. You must be fully qualified in all phases of the examination requirements, regardless of who your examining officer is, and must follow the same procedure with respect to code examiner and witness as specified for the novice or technician examination. Your code speed and technical knowledge must equal the requirements for the higher-grade license. Furthermore, should you later violate any rules or regulations, the FCC reserves the right to call you before an official federal examiner for re-examination, regardless how far you live from an examining point—or even suspend or cancel your ham license. In the long run, it is far better to journey to the examination point, if possible, to obtain your license.

FCC FORMAL EXAMINATIONS

Let us look, for a moment, at the formal examination procedure you must go through to get a general- or extra-class ticket. First, you

must fill out an application form. This is generally done in the FCC office, although you can obtain a form ahead of time and hand it in when you take the examination. The FCC engineer assigned as your examiner is in charge of the examination, and you will follow the procedure he will outline to you. First comes the code examination, both sending and receiving. You will learn, immediately after completing this portion, whether you have passed or failed. If you fail, you are through for this session, but may appear again in thirty days and at thirty-day intervals thereafter until you make the grade. After you have passed both the sending and the receiving code tests, you will be given the technician portion of the examination.

Those taking the novice and technician (as well as conditional) class examinations in their own homes or other familiar surroundings are examined usually by someone they know—a friendly ham, a member of the family, or a sympathetic amateur assigned by the local club perhaps. Human nature being what it is, there is less tendency for you to tense up than when in strange surroundings and sitting across from an examiner you've never met before. But there is no reason to look on the examiner as an ogre, out to eat any victim who appears before him! Quite the contrary, he is a human being like you, and is no more anxious to fail you than you are to flunk. The examiners are all "regular guys," many of whom started just as you are about to do—as hams, and even as novices!

The examining engineer will show you every courtesy. You will enter a quiet room, plainly furnished and free from distracting noises. Here you will meet a number of your fraternity—those about to take their first ham radio examination in a federal office. Relax, you are among friends. Nobody is going to "put the heat on you." Nevertheless, if you're like 90% of the applicants, you'll find yourself biting your lips and fingernails, sweating under the collar, and squirming in your chair! Why? You are not on trial. Nervousness is a human trait that is always more evident under stress. But you are not under stress . . . you are merely in a strange place, among friendly strangers. Take it easy; no one is going to bite you! You are only expected to conduct yourself in the same gentlemanly (or lady-like) manner you would in church or any other public gathering. We have seen applicants, particularly among the younger element, who attempt to allay nervous tension by acting flip or "know-it-all." Don't do it; you aren't impressing anyone—certainly not *favorably!* Act natural and be guided entirely by what your examiner tells you—no "sass" or backtalk, and no questions as to why you have to do this or that. The examination is a firmly established procedure which the examiner knows forwards and backwards. He is your guide; do as he says.

If you will adopt a co-operative attitude, you'll find the examination a genuine pleasure, even though some of the questions may appear a bit tough. They will at least point out your weak spots, to guide you in further study whether you pass or fail. You'll leave the examining room wondering why you were so keyed up beforehand. You'll also have a deep and sincere respect for the FCC people and the exceedingly fair and courteous way they handled you and the other applicants. If you were successful in passing the examination, you will know for sure that you earned it fairly. Should you fail, you can most certainly bet your answers were sufficiently wrong that further study is dictated. Do it; burn the midnight oil if you have to. Then go back in thirty days . . . sixty days . . . ninety . . . whenever you feel you have licked your weak spots and can pass. So take the exam in your stride, admire and respect the excellent job the FCC is doing, and contribute your bit by being gentlemanly, dignified, and courteous while occupying the examination room.

CONCLUSION

We have reached the switch in our journey down the rails of hamdom. You are now about due for diversion from the main line to the sidetrack of specialization. You are going to study for one of the higher grades—general or technician class—and up to a point, you can follow the same roadbed. The technician aspirants will drop off at the first way station if they have assimilated enough theory to make it with their meager knowledge of code. Those shooting for the general class have a bit more of a journey ahead before they reach their utopia . . . a 13-wpm code ability as well as the technical portion. But their rewards will be so much richer, even though the going is a bit rougher and they must "ride the rods" to the destination. All the wonderful experiences and *all* the privileges of ham radio are then theirs for the taking. The choice is yours; aspire to technician or general class as you see fit. Just keep in mind that the higher you go, the more privileges, prestige, and distinction you get. May I say here that I wish every one of you the very greatest success in achieving your goal. I sincerely hope your career as a ham is long, happy, and pleasurable!

APPENDIX A

AMATEUR RADIO BANDS

<i>Meters</i>	<i>Frequency (mc)</i>	<i>Type of Emission</i>
75-80	3.5-4.0	A1
	3.5-3.8	F1
	3.8-4.0	A3 and nfm
40	7.0-7.3	A1
	7.0-7.2	F1
	7.2-7.3	A3 and nfm
20*	14.0-14.35	A1
	14.0-14.2	F1
	14.2-14.3	A3 and nfm
	14.3-14.35	F1
15	21.0 -21.45	A1
	21.0 -21.25	F1
	21.25-21.45	A3 and nfm
10*	28.0-29.7	A1
	28.5-29.7	A3 and nfm
	29.0-29.7	FM
6*	50.0-54.0	A1
	50.0-50.9	A2, A3, A4, nfm
	51.0-54.0	A0, A2, A3
	52.5-54.0	A4, nfm
2	144.0-148.0	A0, A1, A2, A3, FM

For higher frequency bands, consult current handbooks.

* Not available to novices.

A0—Unmodulated carrier.
 A1—CW telegraphy.
 A2—Modulated CW.
 A3—AM radiotelephony.
 A4—Facsimile.
 A5—Television.

F1—Frequency shift keying.
 nfm—narrow-band frequency, or phase-modulated radiotelephony.
 FM—Frequency modulation, radiotelephony, (including nfm), or radiotelegraphy.

APPENDIX B

The following code from the *Radio Amateur's Handbook* is presented here through the courtesy of the American Radio Relay League.

THE AMATEUR'S CODE

ONE THE AMATEUR IS GENTLEMANLY . . . He never knowingly uses the air for his own amusement in such a way as to lessen the pleasure of others. He abides by the pledges given by the ARRL in his behalf to the public and the Government.

TWO THE AMATEUR IS LOYAL . . . He owes his amateur radio to the American Radio Relay League, and he offers it his unswerving loyalty.

THREE THE AMATEUR IS PROGRESSIVE . . . He keeps his station abreast of science. It is built well and efficiently. His operating practice is clean and regular.

FOUR THE AMATEUR IS FRIENDLY . . . Slow and patient sending when requested, friendly advice and counsel to the beginner, kindly assistance and co-operation for the broadcast listener; these are marks of the amateur spirit.

FIVE THE AMATEUR IS BALANCED . . . Radio is his hobby. He never allows it to interfere with any of the duties he owes to his home, his job, his school, or his community.

SIX THE AMATEUR IS PATRIOTIC . . . His knowledge and his station are always ready for the service of his country and his community.

— *Paul M. Segal*

APPENDIX C

CNELRAD RADIO ALERT INFORMATION

Although space prohibits publishing *all* available information on the CONELRAD Alerting Plan, the following table will acquaint you with what to expect from the broadcast station. In the event of a CONELRAD Radio Alert, every AM, FM, and TV broadcast station in operation will follow this procedure:

1. Discontinue normal operation.
2. Cut the transmitter carrier for approximately five seconds.
3. Return the carrier to the air for approximately five seconds.
4. Cut the transmitter carrier for approximately five seconds.
5. Return the carrier to the air and broadcast a 1,000-cycle (approximately) steady tone for 15 seconds.
6. Broadcast the CONELRAD Radio Alert message.

Upon hearing the CONELRAD Radio Alert message, *all* radio stations (including amateur) will immediately cease transmission and listen to the broadcast station on its normal frequency. Upon completion of the CONELRAD Radio Alert message, the station will shift to 640 or 1240 kc, and you should follow it there and continue listening until the all clear is announced. *You will do no transmitting until the all clear has been broadcast.* More detailed information can be had by writing your nearest FCC CONELRAD Liaison Officer, as shown on the accompanying map of Air Defense Force Boundaries on page 126.

CONELRAD MAILING MAP

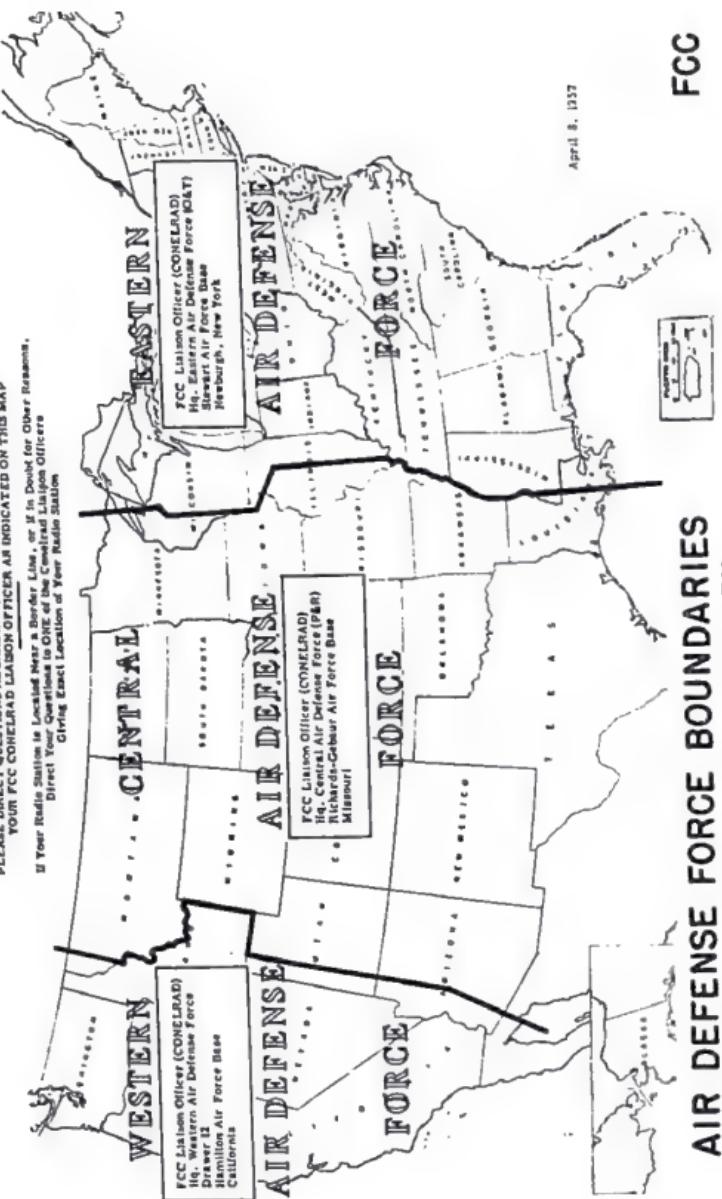
PLEASE DIRECT QUESTIONS REGARDING YOUR CONELRAD RESPONSIBILITIES TO

YOUR FCC CONELRAD LEADERSHIP OFFICER AS INDICATED ON THIS MAP

If Your Radio Station Is Located Near a Border Line, or If in Doubt for Other Reasons,

Direct Your Question to ONE of the CONELRAD Liaison Officers

Giving Exact Location of Your Radio Station



AIR DEFENSE FORCE BOUNDARIES

APPENDIX D

THE "C AND E" FREQUENCIES

For many years, since long before World War I, marine services by international agreement selected 600 meters (or 500 kilocycles, as we now refer to it) as the international calling and distress frequency for all seagoing vessels. All commercial shore stations as well as naval stations guard or "keep watch" on this frequency continuously during the hours they are open. Shipboard operators also are required to guard this frequency continuously during their duty hours.

This assures that any vessel which experiences difficulty can transmit the distress signal—S O S—with a high degree of assurance that it will be heard. All other transmission is suspended while such distress traffic is in progress. Not only is the frequency reserved for distress calls, but it is also available for calling a ship or shore station with routine traffic, knowing that many stations will hear the call, usually including the desired ship or coastal station. Upon establishing contact, both stations then shift to a previously designated working frequency, leaving the 500-kilocycle channel clear for other calls or possible distress communications. However, a short exchange of *Q* signals, or even a short "TR" or position report, can also be sent on 500 kc rather than shifting the frequency, since this type of transmission is of such short duration.

A number of years ago the American Radio Relay League, Inc., the international nonprofit amateur association, introduced a similar practice which, although not legally binding offered advantages closely paralleling those of the commercial marine services.

A definite frequency—designated as the "Calling and Emergency Frequencies"—is assigned for this purpose in each of the popular amateur bands. The co-operation of all active amateurs is solicited in keeping these frequencies clear at all times, except for short calls to a definite station (*no CQ's or general conversation*). Of greater importance, through wide publicity it is hoped all amateurs will realize that, in the event of disaster such as a fire, flood, earthquake, etc., in their vicinity, an emergency call on this frequency will very likely establish communication for them in much less time than a random call on a random frequency.

On the other hand, all amateurs not engaged in actual communication, but who are in the vicinity of their receiver, are requested to leave their receivers tuned to one of the emergency frequencies, in the event some emergency should arise. It is convenient also to tell ham friends, "I'll be around my shack for an hour or so doing a

little work. If you want me, my receiver will be on the C & E frequency." Unfortunately, this practice, which has proven so effective in the marine service that it is legally required, has suffered a decline in ham circles in recent years. Many "old-timers" religiously adhere to this practice and will no doubt continue to do so. It has paid off many, many times during a disaster, as well as proving of real convenience for establishing normal contacts.

The probable reason for the deterioration of this practice is the lack of adequate publicity, so placed that the newcomer to amateur radio will become familiar with it early in his career. Consequently, many newcomers are completely ignorant of the fact that such a system exists, or after listening to this frequency occasionally, abandon it when they hear nothing. If a sufficient number of hams will take an occasional minute to listen to this frequency and leave their receiver on that frequency when they are in their shack but not actively operating, the chances for covering emergency and disaster situations will be increased manyfold. Although the frequencies do not fall within the novice bands, even the novice should listen there occasionally. In the event of a disaster call, he can at least notify the local Red Cross chapter, a local ham with a general-class license, the Civil Defense, or even the local newspaper. These telephone numbers should be conveniently posted at your operating position, where they will be readily available at all times.

In order to familiarize the novice with the proper frequencies for such communication, the following table is presented:

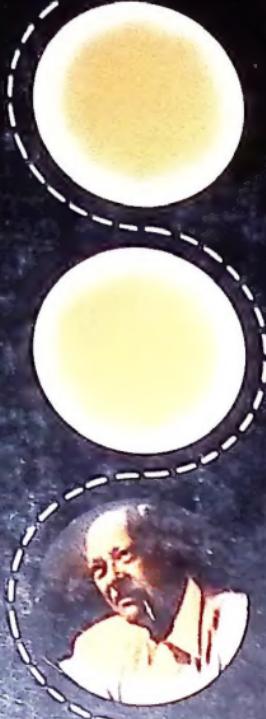
<i>National Calling and Emergency Frequencies</i>			
<i>United States</i>		<i>Canada</i>	
<i>CW</i>	<i>Phone</i>	<i>CW</i>	<i>Phone</i>
3550 kc	3875 kc	3535 kc	3765 kc
7100 kc	7250 kc	7050 kc	-----
14050 kc	14225 kc	14060 kc	14160 kc
21050 kc	21400 kc	-----	-----
28100 kc	29640 kc	-----	28250 kc
-----	50550 kc	-----	-----
-----	145350 kc	-----	-----

QRRR is the official ARRL amateur SOS. It should be used *only* for an emergency call by a station seeking assistance.

Although the C & E frequencies are *not* legally authorized for a novice station, novice-class operators should familiarize themselves with the procedures through frequent listening.

BOOST the C & E frequency idea to others, and USE it when you become a general-class operator!





BUILDING UP YOUR HAM SHACK

by HOWARD S. PYLE • W7OE

Perhaps you've just received your coveted novice ticket and are champing at the bit to get your ham shack together and operating . . . or maybe you've been on the air for some time now, but are thinking of acquiring additional equipment . . . or you may still be dreaming about the day when you will go on the air with your first CQ. If any of these situations describe you, you'll want this book. Not only does it explain how to assemble your first ham station and how to choose and install your equipment, but it will also guide you in the choice of advanced equipment so that you can gradually upgrade your station until it is the envy of the airways. Suggestions on "trading up" will help you attain this goal at a minimum expense. You'll also find suggestions on test and measuring equipment for use in your ham workshop. A comprehensive appendix and index have been added to make "Building Up Your Ham Shack" as useful as possible.



HOWARD W. SAMS & CO., INC.
THE BOBBS-MERRILL COMPANY, INC.